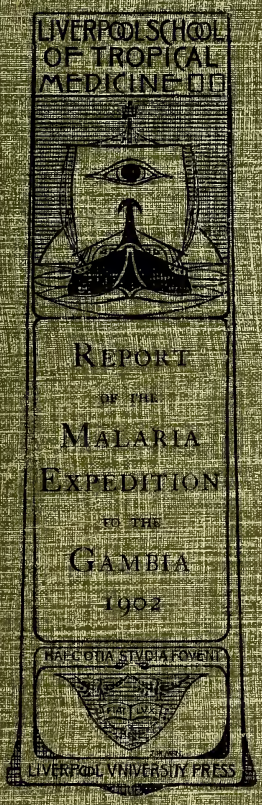

J. EVERETT DUTTON, M.B.

APPENDIX BY

F. V. THEOBALD, M.A.

REPORT OF THE
MALARIA EXPEDITION TO THE GAMBIA

LIVERPOOL SCHOOL OF TROPICAL MEDICINE—MEMOIR X

REPORT

OF THE

MALARIA EXPEDITION TO THE GAMBIA

1902

OF THE

LIVERPOOL SCHOOL OF TROPICAL MEDICINE
AND MEDICAL PARASITOLOGY

BY

J. EVERETT DUTTON, M.B., B.CH., VICT.

AND AN

APPENDIX BY F. V. THEOBALD, M.A.

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OF THE

LIVERPOOL SCHOOL OF TROPICAL MEDICINE AND MEDICAL PARASITOLOGY

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ERRATA

In acknowledgment, line 11, for 'Lieut. G. C. Young,' read 'Lieut. G. C. Tracy.'

P. 4, l. 23. For 'regular,' read 'irregular;' for 'rarely,' read 'readily;' for 'up,' read 'off.'

P. 9, l. 33. For 'Lieut. Young,' read 'Lieut. Tracy.'

P. 10, l. 19. For 'Mr. Barnois,' read 'Mr. Budgett.'

P. 10, l. 24. For 'cus cus,' read 'koos-koos.'

P. 10, l. 34. For 'Lieut. Young,' read 'Lieut. Tracy.'

P. 21, last line. For 'ground,' read 'drain.'

P. 26, l. 21. For 'mosquito' read 'mosquitoes.'

P. 33, l. 22. For 'mosquito-room,' read 'anti-mosquito-room.'

P. 34, l. 5. For 'country,' read 'community.'

P. 34, l. 37. Before 'water,' read 'tidal.'

P. 36, l. 36. Professor Herdman has recently kindly identified for me the specimens of fish taken from the main drains of Bathurst; two specimens so far occur. They are:—

Hemichromis bimaculatus (Gill).

Chromis macrocephalus (Bleeker).

P. 39, l. 30. For 'great,' read 'greater.'

REPORT OF THE LIVERPOOL MALARIA EXPEDITION TO THE GAMBIA

I. PRELIMINARY

DURING the past two years a great deal of energy has been displayed in many parts of the world to put to some practical use the great discovery of the definitive host of the malaria parasite. The knowledge that the mosquito is responsible for the transmission of malaria has immensely increased the possibility of combating this disease by prophylactic measures. The measures which have been recommended by various investigators naturally group themselves under two heads—

1. Destruction of the parasite in its intermediary host, man.
2. The prevention of the transference of the parasite from one host to the other, viz., from man to mosquito, or mosquito to man.

Under the latter group many methods have been advocated, and much literature has accumulated during the last three or four years. The modes of attack have centred round the vulnerable stage in the life cycle of parasites in general, viz., the transference from one host to another; thus in the case of the malaria parasite the points aimed at in this stage are—

1. Destruction of the definitive host, the mosquito.
2. The prevention of infection of the mosquito.
3. The prevention of inoculation of man by the mosquito.

It was hoped in the early stages of the work of investigation on the mosquito cycle of the malaria parasite that it would be a matter of comparatively little difficulty to destroy the parasite in this stage of its history by means of the destruction of the mosquito carrying them, especially as only one genus of the *Culicidae* (*Anopheles*) was implicated. Major Ross, in India, and other investigators had pointed out the broad fact that the genus *Anopheles* required, as a rule, breeding-places of a rather special character for their propagation, very shallow surface pools of sufficient depth to last over a week. By the prevention or treatment of these pools it was thought that the mosquitoes could be done away with. Maps were made marking out the distribution of such breeding places throughout certain districts with this object in view. Later on it was shown that certain members at least, if not the whole genus *Anopheles*, did not necessarily require such specialized breeding places, for if from any cause they were absent these mosquitoes would breed in any collection of water, just as the genus *Culex* does.

Up to 1899 some one hundred and twenty-two definite species of the *Culicidae* were described. Since that time many collections of mosquitoes have been examined from all parts of the world. Mr. F. V. Theobald, at the close of last year, as the result of an exhaustive examination of past works and new material, has remodelled the classification of the *Culicidae*, which he has grouped into some twenty-two genera, and has described some one hundred and thirty-six distinct new species in his *Monograph on the Culicidae of the World*. To this number must be added some one hundred new species which he has not yet described.

As yet only a few of the great number of mosquitoes have been investigated with regard to the important point of whether or no they can act as hosts for the malaria parasite. In fact only a few species of *Culex* have been shown to be incapable of transmitting the disease.

When it was considered that not only malaria but other diseases were conveyed by mosquitoes, for example, filaria can develop in two genera, *Culex* and *Panoplites*, and that yellow fever is certainly carried by one genus, *Stegomyia*, there arose a tendency to look upon all mosquitoes as harmful, and that their judicial destruction, as far as possible, was an object to be aimed at. How far this end can be attained is at present *sub judice*, but we have evidence that certain districts and towns lend themselves readily to this object.

Experiments under this head are at present being carried on in West Africa and in Havana. On a smaller scale similar experiments have been carried out in Hong Kong and Statin Island, New York. Major Ross chose Freetown, Sierra Leone, for the scene for an experiment, to see how far mosquitoes can be diminished in a certain area, one of the most difficult places on the West Coast to tackle. He and Dr. Logan Taylor, who was to direct the work there, arrived on July 2, 1901, and at once commenced the campaign against all varieties of mosquitoes. As yet the experiment is not completed, but a great diminution in the numbers of these insects has already been brought about.

In Havana the work of exterminating mosquitoes, by the destruction of their breeding places, was commenced soon after the discovery that yellow fever could be transmitted by the bites of the common mosquito, *Stegomyia fasciata*. Major and Surgeon W. C. Gorgas, in his January report to the Military Governor, states that out of seventeen thousand houses examined during the month by the 'Stegomyia Brigade,' in four hundred and eleven only were mosquito larvae found; the preceding January, larvae would have been found in all of the houses. Not only have the mosquitoes diminished, but Havana has been for the last four months, October, November, December, January, entirely free from yellow fever. This result is certainly very encouraging when we compare the prevalence of yellow fever there during the same period of the previous year, when the average number of deaths from this disease was 146·49.

II. TOPOGRAPHY AND STATISTICS

St. Mary's Island and Bathurst

St. Mary's Island is a long, low-lying island at the mouth of the River Gambia, extending roughly from north-east to south-west along the south bank of the river. It is about four miles long and half-a-mile across at its widest part. The island is only separated from the mainland by a small creek, which, at the north-west corner, is bridged across. One fairly good road runs the length of the island, from the town of Bathurst at the one end to the Creek Bridge. This road runs along the beach, separated from it for the most part by mounds of sand and scrub. On the south side of the road an extensive mangrove swamp occurs, and in places encroaches on to the road.

The town of Bathurst is situated at the east corner of St. Mary's Island. It occupies an ⊥-shaped area of land, the long arm of which is almost separated from the island by an encroachment of Oyster Creek at the back of the island and the mangrove swamp. There is only a distance of some two hundred yards between the swamp and the beach, so that this area is for the most part cut off from the island, and is surrounded by a broad expanse of water on all sides, to the north and west by the River Gambia, which is here about four miles across, to the south and west by the creek separating St. Mary's Island from the mainland. In this area the land scarcely reaches the height of four feet above sea-level, the greater part of it being situated below the sea-level. Altogether it is scarcely a square mile in extent.

The formation is of light sand and loam on the surface, followed by denser loam which rests upon the water-bearing sand and silt, about eight feet under the surface. This area is well though not too thickly wooded ; some very fine trees occur in the town.

The town of Bathurst is very well laid out. The chief streets are broad and run parallel and at right angles to one another ; in fact there are very few narrow streets, even in the strictly native quarters. The chief houses and factories in the principal street, Wellington, face the mouth of the river. These houses are built of stone for the most part, the volcanic iron stone which occurs in great quantity across the river. These houses are very cool and airy, and the rooms are large ; they were probably built by the French. At the back of each house there is generally an enclosed piece of ground used as a garden.

Unfortunately, in Bathurst, the houses of the Europeans are not segregated from the natives, many of the traders' and officials' houses, particularly, being surrounded by native compounds. Government House, the Colonial Secretary's house,

the Hospital, and the Telegraph Station are slightly better in this respect, but here only a road (Clifton Road) and an open space about one hundred yards across separate them from a bad portion of the native town (Portuguese Town), and on this portion of land a few huts are present.

In the centre of Bathurst there is a fine open space, McCarthy's Square. On one side of this square is a very picturesque building, the Barracks, occupied during the time I was at Bathurst by a West Indian Regiment. The creek separating St. Mary's Island and the mainland commences at the back of the town of Bathurst ; and here it is about half-a-mile to a mile across. The ground in this part of Bathurst is very low-lying, and parts of it are below sea-level. To prevent the encroachment of tidal water a wall two to three feet high has been built. This wall extends for a considerable distance, the remainder being a mud embankment. Within this ⅃-shaped area of St. Mary's Island described above two large swamps occur, namely, Half Die and Box Bar. The former swamp is situated in the smaller arm and is not tidal, owing to the low wall mentioned above. Native compounds occur all along these marshes, which in the wet season are often covered with water. Down the centre of this swamp a wide channel runs and opens into the creek by means of sluice gates.

The other swamp, Box Bar, is situated at the back of the town, in the larger arm of land ; along its centre an open drain runs, which falls in a similar manner by means of sluice gates into the creek. On either side of this swamp the native town extends for some distance, as Portuguese Town on the one hand and New Town on the other. This swamp is larger than the preceding one and is partially covered by rank grass and low scrub. Its surface is much more regular, so that the collections of water are rarely shut up from the central channel ; there appears to be a distinct fall, though slight, from the sides to the centre. Both of these swamps in the dry season only contain tidal water, which oozes through the sluice gates and sand into the central channel. In the wet season they practically act as reservoirs for rain-water. There is, besides, another smaller swamp.

Population of Bathurst.—The European population of Bathurst varies slightly during the year, some of the officials and traders returning home during the wet season. There are some seventy to eighty persons. The native population is estimated at about fifteen thousand ; they include the Joloffs, Mandingoes (Mohammedans), and a small number of Jolahs (Pagans), and a good few Sierra Leone traders. Besides this there is a small fluctuating population of Assyrian traders, estimated at about one hundred. These people trade in small articles among the natives, and live in an extremely filthy condition. A few cases of yellow fever which occurred in Bathurst last year were supposed to have arisen by means of these people.

Drainage of Bathurst.—Provision is made for the carriage of surface water by means of open gutters, which run down the centre of the main streets. These open channels commence at the higher portion of the town as shallow gutters, about

eighteen inches deep. During their course along the streets they are made deeper in order to obtain a good fall until they reach the beach, where some are thirteen feet deep and three feet wide. Similar drains from the side streets enter at right angles into these drains ; the water from them is discharged into the river by means of sluice gates, which are opened at low tide. Altogether there are about half-a-dozen such gates. The construction of the drains varies to a considerable extent. The main drains opening into the river are square, flat-bottomed, built of stone, lined with cement, and are for the most part impervious. Further in the town the channels are built with stone, but some of them are only partially cemented, either the iron-stone blocks on the sides or the bed of the drain being uncemented. These channels allow the ground-water to percolate into them at certain seasons of the year. Still further in the centre of the town the drains become very shallow and are made of bricks, trough-shaped and uncemented.

Many of the streets have no 'made' drains as described above, instead, a centrally situated trench is dug in the ground, which either discharges into the main drain or discharges at the back of the town, directly into the swamp. These trenches vary considerably in depth and width, some of them being four feet from the surface of the ground. In some of the drains the earth dug out to form the trench is built up on either side of it so that the surface of the street falls away from the trench. Similar trenches occur round compounds, squares, and in the grounds of the Europeans. They are for the most part choked with grass, or natives walking across from one side of the street to the other carry with them sand or débris, converting the drain into a series of holes in the centre of the street ; some of them are so choked in this way along their course and at their outlets that it is impossible for the contained water to escape. At the corners of the principal streets these drains are bridged over by low brick arches. In this situation the drain frequently has a stone placed in its course or a cemented catch-pit has been constructed ; here water lodges for a considerable period after the rain has ceased. Later on it will be shown how many of these drains afford considerable breeding-grounds for mosquitoes.

Water Supply.—Rain-water is used for drinking purposes by the Europeans, and also by some of the native traders. It is gathered from the roof and stored in large tanks. Some of these tanks are fitted with good covers, others are not covered properly, so that insects, dirt, etc., contaminating the water, obtain an entrance beneath the cover of the tank. The best tank seen was one in which the only mode of access to the tank was by means of a man-hole at the top, with a heavy, fluted, iron lid, difficult of removal. Some of the native traders also collect rain-water in large iron boilers or tubs. These are for the most part inadequately covered, or not at all. For domestic purposes, water is obtained by the Europeans from wells sunk in their gardens. The native population of Bathurst obtain water solely from wells.

The wells of Bathurst are of two types, namely, deep wells and shallow or tub wells.

The deep wells occur as public wells, built by the Government. In the streets in various parts of the town there are about a dozen altogether. Similar wells are present in some of the European and native traders' compounds. They are on the whole well built of stone and steined with cement for a good distance down. A wall two feet high generally surrounds the well, but unfortunately very few of them are covered in. Of fifty-five private wells examined only thirteen were properly covered ; of the public wells, one only. Thus it is an easy matter for these wells to become foul ; this is generally due to sticks, half-peeled oranges, pawpaw rinds, and other rubbish thrown in by children. The depth of these wells varies from fifteen to twenty feet. The second class of well, the small tub well, occurs chiefly in the native compounds and in the gardens of the Europeans. They are very shallow, a hole being dug about three feet in the ground by a native and a barrel inserted into it, in which water collects. The rim of the tub may be flush with the ground, but it is generally about four to six inches above. Close to these small wells in the native compounds, in many instances scarcely four yards away, occur the cess-pit or midden and the screened-off personal wash-place. It is not difficult to understand how easily polluted these wells become. Many of the natives appreciate this, and on enquiry will tell you that they go to the public wells to get water for drinking purposes.

Climate of Bathurst.—With regard to climate, Bathurst represents a contrast to other parts of the Coast. Its situation on an island surrounded almost on all sides by a broad expanse of water tends to modify the extreme heat and dampness met with in other parts of the Coast. The dry season commences at the end of October and ends at the beginning of May. During these months the harmattan blows from the interior, and great variations between the maximum and minimum temperature may be recorded, a temperature of 100° during the day, while at night it is not unusual to have a temperature of 60°. These months are very trying to the native population, and many cases of bronchitis and pneumonia occur amongst them. During this season practically no rain occurs. The wet season sets in in June and ends in September. In the months before and after this period, that is April and October, some heavy showers may occur. In these months the temperature is much more even. The highest maximum recorded in the shade never reaches 100°, at least has not done so for the past five years ; it is generally about one or two degrees above 90°. The lowest minimum temperature recorded for these four months keeps about 70°. Chart (I) gives a record of the temperature of the maximum and minimum for 1900. For the last five years charts constructed in a similar way show practically the same curves. The rain-fall of Bathurst does not vary much above fifty inches, and this occurs in the four months, June, July, August, September. In October the wet season ends. After October rapid drying takes place. The wet season, owing to the great humidity and absence of any appreciable variation in atmospheric temperature, is exceedingly trying to Europeans.

Food.—Europeans at Bathurst are fortunate with regard to fresh food ; fresh meat can be obtained every day. There is a special slaughter-house for cattle, situated behind the market, which is under the supervision of the Sanitary Board. Fish is brought into the town twice daily, and is of excellent quality. Very good bread can be obtained from the various traders, particularly the French Companies ; the smaller native traders also sell bread in the market. Throughout the dry season English vegetables of all kinds are easily obtainable. Many of the European officials and European traders make a point of growing these vegetables, and I observe that the natives are, in a small way, imitating the Europeans in this respect. Many of them grow onions and tomatoes to sell in the market. Through the energy of the French Company ice can be obtained all the year round.

Disposal of Refuse.—Amongst the Europeans, sand closets are almost universally used, being emptied every day by a staff of night-soil men. With regard to the natives, public latrines are provided by the Government. At times it happens that excretal matters are washed by the tide on to the foreshore. In the compounds of the more wealthy class of natives middens are used ; some of these are of very large size, and are not made impervious to water. In the smaller compounds a tub placed in the ground is used as a privy. Only occasionally earth or lime is mixed with the excretal matter. When full, which takes from one to two years, the tub is discarded and another inserted in a fresh place in the compound. Both the tubs and privies were found to be infested with multitudes of fly maggots. The Jollofs, who constitute about one-third of the population of Bathurst, have no middens or tubs in their compounds ; instead, an earthenware jar is used to retain excreta, the jar being emptied every day, either in the morning or at night, into the river. These people are particularly clean and tidy and take a pride in keeping their compounds in good order. Dry refuse is removed from the various compounds by the Sanitary Board's carts, which go round the town every day ; this refuse is dumped on the borders of Box Bar swamp.

Prevalence of Malaria Fever in Bathurst.—With such a comparatively small and fluctuating white population in Bathurst it is difficult to estimate exactly the prevalence of malarial fever amongst the Europeans. From the medical officers' reports, which the Colonial Surgeon, Dr. R. M. Forde, very kindly allowed me to consult, I was able to obtain the following data for the last three years :—In 1898, out of a total European population of sixty-three, twenty-three persons were admitted into the hospital for various diseases, but principally for malarial fever. There were three deaths for the year, two from haemoglobinuric fever and one from malarial cachexia ; during the year there were four cases of blackwater fever amongst the non-official European residents. In 1899, out of a population of eighty, twenty were admitted during the year into the hospital, chiefly for malarial fever. Of the non-official white population sixty-six were treated during the year ; of these thirty-seven were cases of malarial fever of the remittent type and three were cases of haemoglobinuric fever ;

there was one death from cardiac failure after enteritis. In 1900 there were eleven Europeans in the hospital ; two deaths occurred, one from dysentery, the other was a sailor landed in Bathurst with an abscess in the brain. Of the non-official Europeans sixty-nine were under medical treatment ; of these thirty-five were malarial fevers of the remittent type, with one death ; seven were believed to be yellow fever, with six deaths. It is stated in the reports that the severe cases of fever occur during the latter part of the year, from July onwards, that is, after the wet season has fully set in. In connexion with these figures the Colonial Surgeon points out that a fairly large percentage of Europeans return to England during the wet months. During the past year, 1901, there has been stationed in Bathurst a company of the West Indian Regiment. These men, though drafted from Sierra Leone, had for the most part originally come from Barbadoes and other West Indian Islands where endemic malaria does not exist, thus they were in the same category as the white man entering an endemic malarial district, and were therefore specially suitable to study the liability to infection with malarial fever. Further, no special precautions were taken amongst them to ward off attacks from mosquitoes, nor was quinine administered as a prophylactic. The men arrived in April, and were quartered in the barracks, McCarthy Square. Some of them went away for a short time in the early part of the year on a punitive expedition against some tribes up the river ; altogether there were one hundred and eight men. The following chart shows the percentage of cases amongst

(Chart I)

this force admitted into hospital with malarial fever during each month from April, 1901, to January, 1902, indicated in the chart by the thick line. The fever was for the most part remittent in character, and the diagnosis was to a large extent confirmed by microscopical examination of the blood. The curve does not represent the total number of malarial fever cases occurring amongst the soldiers, as many soldiers suffering from only slight attacks of fever were not ill enough to be admitted into hospital. With this chart is also given the rainfall in inches, and the maximum and minimum temperatures in the shade for the year. It will be seen that the greatest percentage of malarial cases occurred in the months of September, October, and November, and that there was a marked decline from December to January ; in the latter month no cases occurred. During the former months innumerable mosquitoes are present in Bathurst ; the rainy season being fully established during July and August has so raised the level of the ground water that many suitable breeding-places occur along the borders of the swamp and in the drains, etc. Besides the old observations illustrated in this chart of the relation between rainfall and malarial fever, it is also interesting to note that the greatest percentage of malarial fever cases amongst the soldiers also occurred in those months when the variations in atmospheric temperature are least marked, namely, July, August, September, October. The average variations between the maximum and minimum temperatures in the shade in these months

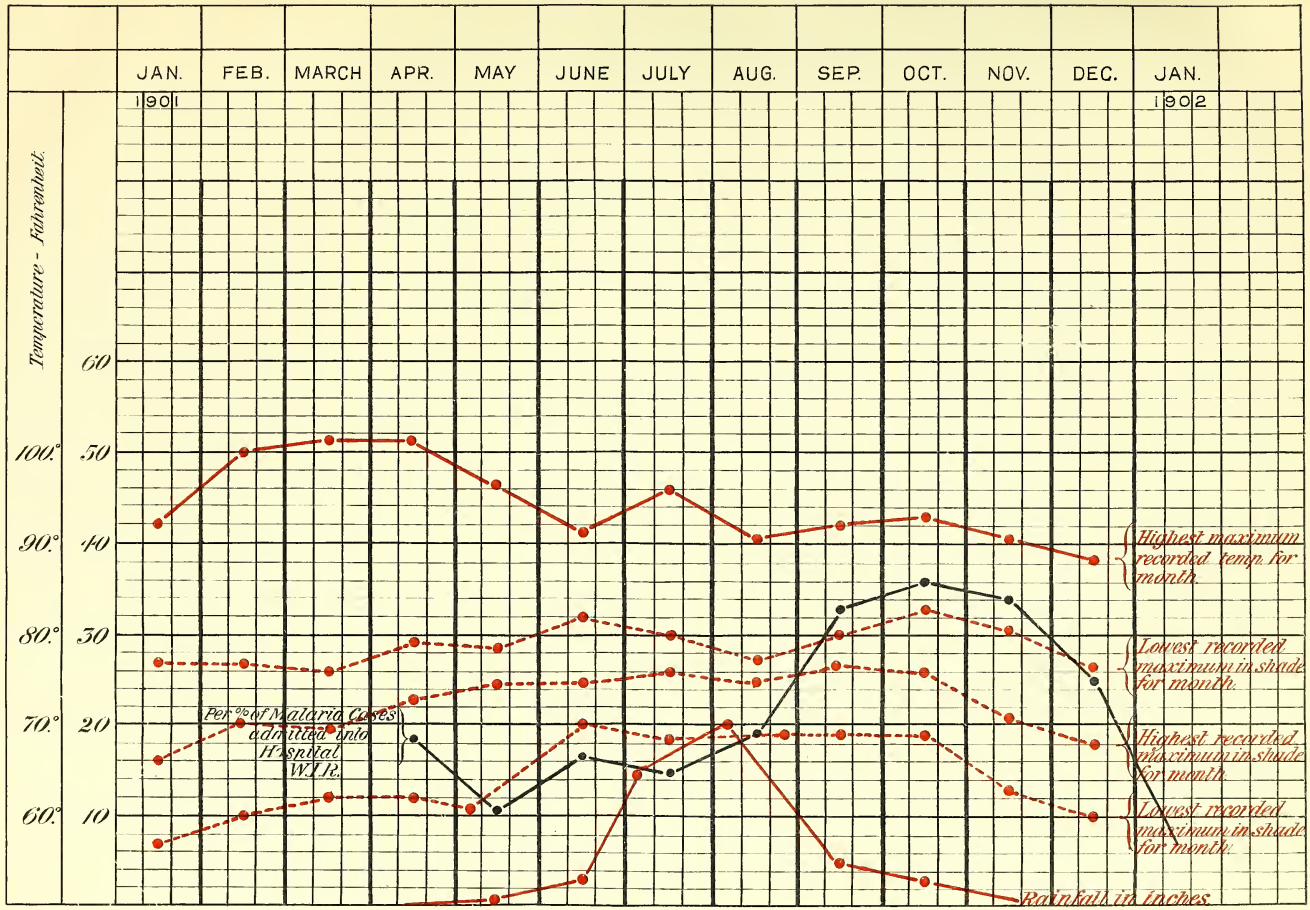


Chart I. Fever cases amongst the West Indian Soldiers stationed at Bathurst with rainfall and temperature curves for year.

being 25°, while in January, February, March, April, and May the variation in temperature is not less than 40° ; it would appear, then, as pointed out by Dr. R. M. Forde in his Medical Report, that the liability to infection occurs soon after the rains are established, lasting up to the end of November.

Cape St. Mary

About seven miles from Bathurst, on the mainland at the mouth of the River Gambia, is a promontory known as Cape St. Mary, or simply the Cape. The road from Bathurst leads directly to it, and is perfectly level until a distance of about three hundred yards from the Cape is reached ; the ground then rises rather suddenly to the summit of the promontory about one hundred feet. Cape St. Mary is the termination of the low cliffs of volcanic and sandstone rock which skirt the sea border to the south of the River Gambia. I had an opportunity of staying there two days in the Government House, which is built on the edge of a cliff facing the sea, and is now used principally as a convalescent station. Besides Government House, a few traders and others have built bungalows here and there along the cliffs. On either side of the road leading to Government House, and extending from right to left, is a large Mandingo town, and at the foot of the hill itself is an extensive swamp in which the natives grow their rice. There is no doubt that the climate at the Cape is very bracing and very beneficial to convalescents after fever. It is extremely unfortunate that Government House is situated so near the native village, in which endemic malaria and other diseases are very prevalent, and also that the rice swamp is so close at hand, breeding millions of mosquitoes, which not only cause much annoyance but are a real danger to the residents in the house. This swamp had not completely dried up on December 27, when I examined it, although there had been no rain for two months previously. Many mosquitoes were still breeding in the puddles ; it would appear that even during the dry season mosquitoes infest the district, and in fact I had no difficulty in obtaining them for examination. The natives collected very many for me from their huts, and these for the most part belonged to the *Anopheles* genus. About a mile away from the Cape, on the Coast, is another promontory jutting out into the sea. This presents an ideal site for a Sanatorium, as the land at the back is high and level for a considerable distance stretching into the interior, and also no native huts appear within a radius of a mile.

I took the opportunity of travelling with Lieutenant Young to see some of the stations up the river. Unfortunately only a short time was at my disposal, so that no detail work could be done. We travelled up river in December, when the dry season was fully established. At McCarthy Island, one hundred and fifty-three miles up, is the most important station ; here there is a Government House and a few traders' factories. The island is very low-lying and swampy ; a rice swamp, at this time dried up, lies by the edge of the river. Close to the principal native

town, and behind the town, half-a-mile away, there is also another large swamp running along the centre of the island, probably the old course of a river. In the large swamps innumerable mosquitoes occurred. Government House is situated close to the native town, surrounded by old stone ruins, which afford suitable hiding-places for mosquitoes in the dry season ; there were many mosquitoes about. One European was staying in the Government House when we visited it, and in his room I found, in the middle of the day, innumerable specimens of *A. funestus* and its varieties resting on the walls. A well present in the compound was devoid of *Anopheles* larvae, though larvae of the *Culex* type were present in numbers. These mosquitoes must have either flown from the swamp at the back of the town, where I found larvae in amongst the grass, or must have been bred in the river ; here I failed to detect larvae ; small fish occurred in the crevices and bays of the bank. The native town is similar to Bathurst, trenches in the streets drain into the river, and in the wet season, in consequence, innumerable breeding-places for mosquitoes are formed. Water is obtained by the natives from the river, as there are no wells. McCarthy Island appears to me to be quite unsuitable to permit of preventative operations against mosquitoes. One must rely on such means as segregation and personal precautions against these insects. This latter method of precaution was, I believe, very successful in the case of Mr. Barnois, who, in 1898, stayed at McCarthy Island for some time without taking malaria fever, a mosquito net being successfully used.

A native Mandingo town, Baia, was visited, and the country round explored. This town was situated two miles away from the river. The country round was perfectly level, most of it being cultivated ; ground-nuts, cuscus, and a bean being the chief products. Everywhere the ground was dried up within a radius of two miles ; there were no breeding-places for mosquitoes within this radius, except one very deep well, forty feet, which had been discarded ; in this well only the *Culex* type of larvae occurred. In the huts innumerable quantities of *Anopheles funestus* and its varieties occurred, which could be obtained at any time of the day off the walls. So completely was there an absence of water that, at the margin of a well from which water was constantly being drawn, bees, butterflies, and other insects were present in great numbers, drinking up the water spilt on the ground. At this time of the year the only breeding-places for mosquitoes are in the neighbourhood of the swamps two miles away. Lieut. Young informed me while out shooting that he came across a tub in some fields a short distance from the town in which mosquito larvae were present. I searched along the margin of these swamps, but I failed to obtain larvae here or in the pools dug out for cattle.

III. ENDEMIC MALARIA IN THE GAMBIA

The discovery, both by Professor Koch in German East Indies, and by the members of the Royal Society Malaria Commission in West Africa (1900), of the prevalence of malarial parasites in the blood of native children in an endemic area up to twelve years of age has given us a method by which a correct estimation of the presence and the extent of malaria in a district can be ascertained by the systematic examination of the blood of the children.

While in the Gambia I obtained some one hundred and thirteen children from 0 to 15 years of age for examination; the children were chiefly from the town of Bathurst and a native town seven miles away at Cape St. Mary; a few were also available for examination at a small Mandingo town, Baia, one hundred and eighty-five miles up the river. At Bathurst the children examined were those who came to the out-patient department to be treated for various ailments, or were brought by their mothers, who had come themselves for treatment. Fourteen in all were obtained in this way, only one of them showing signs of fever (101·8°) at the time of examination; some were treated for worms, bronchitis, or injuries. The remainder of the children examined were those who came to be vaccinated at the house of the Public Vaccinator, Dr. Taylor; they were, to all appearance, in good health. At the Cape and Baia the children were brought to me by their parents. The blood of many of the children at Bathurst was examined in the fresh condition, as well as by means of smears made in the usual way on a glass slide; all the smears were stained by a modification of Romanowsky's method, recommended to me by Dr. MacConkey.

From the table (No. I) given below it will be seen that **eighty per cent. of the children examined harboured malaria parasites in their blood,** and these occurred in children practically equally up to ten years of age (the numbers are too small to give correct percentages at the various age periods). After ten years of age, out of thirteen cases examined seven were found infected; in these cases the malaria parasites were rare in the blood; in fact, in all except in one case, the parasites encountered on the films were very few.

TABLE I

SHEWING NUMBER OF CHILDREN IN THE GAMBIA EXAMINED AND FOUND INFECTED WITH MALARIA PARASITES

Age	No. Examined	No. Infected	Percentage Infected
0-1	18	13	—
1-2	13	11	—
2-3	13	11	—
3-4	17	15	—
4-5	17	14	—
5-6	9	8	—
6-7	4	4	—
7-8	5	4	—
8-9	2	2	—
9-10	2	2	—
10+	13	7	—
	113	91	80
0-5	78	64	82
5-10	22	20	91
10-15	13	7	53·8

Time and opportunity did not permit of the collection of a larger series of cases; it was found especially difficult to obtain children for examination in country districts; still it will be seen that the malaria index in Bathurst is very high, and consequently the chance of infection for the new-comer under suitable conditions is also very great.

It is of interest to note the high percentage of quartan parasites (*Haemamoeba malariae*) among the cases examined, viz., 31·8 per cent., and also the large percentage of crescents (*gametocytes*) observed in the blood, viz., 32·3 per cent., in those cases in which the aestivo-autumnal fever parasite (*Haemamoeba praecox*) occurred. I believe this large percentage has not been observed before on the Coast.

The parasite of tertian fever (*Haemamoeba vivax*) was only found in three cases.

The children infected at Bathurst came from all parts of the town, and no indication was obtained from the examination of their blood that malaria was less prevalent in one street than in another; considering the small size and the equal distribution of suitable breeding-places for the malaria-carrying mosquitoes throughout the town, it is not to be expected that at any one part the malaria index would vary. Table II gives the results of the child examination in the Gambia.

TABLE II

Shewing the Number Infected and Nature of Infection in Children of the Gambia

Children at Bathurst—

Age	No. Examined	No. Infected	Nature of Infection. Remarks
0-1	15	11	(1) Age ten months, blood very watery, aestivo-autumnal ring forms, crescents (in fresh preparation flagellation took place rapidly), pigmented mononuclear leucocytes (2) Age three months, aestivo-autumnal ring forms, pigmented mononuclear leucocytes (3) Age eight months, small aestivo-autumnal ring forms, few crescents (4) Age six months, large and small quartan forms, pigmented mononuclear leucocytes (5) Age two months, many aestivo-autumnal ring forms, one crescent, pigmented mononuclear leucocytes (6) Age seven months, many aestivo-autumnal ring forms, crescents, pigmented mononuclear leucocytes (7) Age eleven months, aestivo-autumnal ring forms (8) Age eight months, few aestivo-autumnal ring forms, one crescent (9) Age ten months, aestivo-autumnal ring forms (10) Age eight months, aestivo-autumnal ring forms, pigmented mononuclear leucocytes (11) Age eight months, many ring forms, double infection of corpuscles, pigmented mononuclear leucocytes Three of the children not infected were under three months old.
1-2	11	9	(1) Many aestivo-autumnal ring forms, pigmented mononuclear leucocytes (2) Ditto (3) Ditto (4) Ring forms, large quartan parasites, flagellating forms in fresh slides, in stained slides many quartan gametocytes, pigmented mononuclear leucocytes (5) Aestivo-autumnal ring forms, pigmented mononuclear leucocytes (6) Ditto (7) Quartan parasites all stages, few gametocytes, pigmented mononuclear leucocytes (8) Aestivo-autumnal rings, numerous pigmented mononuclear leucocytes (9) Few aestivo-autumnal ring forms, numerous pigmented mononuclear leucocytes
2-3	5	4	(1) All stages of quartan (2) Aestivo-autumnal ring forms (3) Ring forms, large forms quartan (4) Very numerous aestivo-autumnal ring forms, pigmented mononuclear leucocytes. This child was an Assyrian; had fever two weeks ago; temperature was 97·4 on examination

Children at Bathurst—continued—

Age	No. Examined	No. Infected	Nature of Infection. Remarks
3-4	5	5	(1) One crescent present (2) Ring forms, large quartan parasite, one crescent (3) Few aestivo-autumnal ring forms (4) Many aestivo-autumnal ring forms (5) Few aestivo-autumnal ring forms, twelve crescents, which had not changed after two hours, were counted in drop of blood, others had flagellated very soon after the blood was drawn
4-5	9	7	(1) Three crescents in slide (2) Large and small quartan forms, pigmented mononuclear leucocytes (3) Few aestivo-autumnal ring forms, pigmented mononuclear leucocytes (4) Ditto (5) Ditto (6) Ring forms, half-grown quartan parasites, pigmented mononuclear leucocytes (7) Large quartan forms, pigmented mononuclear leucocytes
5-6	1	0	
6-7	3	3	(1) All stages of quartan parasite, pigmented mononuclear leucocytes (2) Quartan parasites, pigmented mononuclear leucocytes (3) Aestivo-autumnal ring forms, one crescent
7-8	2	1	(1) Few aestivo-autumnal ring forms, one crescent, pigmented mononuclear leucocytes
8-9	0	0	
9-10	2	2	(1) Few small and half-grown tertian parasites, tertian gametocytes (2) All stages of quartan parasites
10+	5	2	(1) Age ten years, only one aestivo-autumnal ring form present in slide (2) Age eleven years, four aestivo-autumnal ring forms present in slide. The ages of the non-infected children were fifteen, fourteen, fifteen years, respectively

Children of Baia—

Age	No. Examined	No. Infected	Nature of Infection. Remarks
2-3	3	3	(1) Many aestivo-autumnal parasites (2) Ditto (3) Ditto
3-4	1	1	(1) Few aestivo-autumnal parasites
4-5	1	1	(1) Pigmented mononuclear leucocytes, few aestivo-autumnal parasites
5-6	1	1	(1) Large tertian parasites
7-8	1	1	(1) Few aestivo-autumnal ring forms
10+	3	2	(1) Few aestivo-autumnal ring forms (2) Ditto
	10	9	

Children at the Cape—

Age.	No. Examined	No. Infected	Nature of Infection. Remarks
0-1	3	2	(1) A few aestivo-autumnal ring forms, two crescents (2) Ring forms, large quartan parasites
1-2	2	2	(1) Ring forms, large quartan forms, quartan gametocytes (2) Three crescents, ring forms, large quartan forms, quartan sporocytes, pigmented mononuclear leucocytes
2-3	5	4	(1) Few aestivo-autumnal ring forms (2) All stages of quartan parasites (3) Aestivo-autumnal ring forms, one crescent (4) Sporocytes, gametocytes, and small forms of quartan
3-4	11	9	(1) Ring forms, sporocytes and gametocytes of quartan (2) Aestivo-autumnal rings (3) Few aestivo-autumnal rings (4) Quartan gametocytes (5) Few aestivo-autumnal ring forms, few crescents (6) Very few small quartan forms, quartan gamecocytes (7) Ring forms, few half-grown quartan forms (8) Few aestivo-autumnal ring forms. In this slide three trypanosomes were present[1] (9) Aestivo-autumnal ring forms, one crescent
4-5	7	6	(1) Few aestivo-autumnal parasites (2) Ring forms, half-grown quartan parasites (3) Small quartan parasites (4) Small quartan form, quartan gametocytes (5) Quartan gametocytes and small forms (6) Aestivo-autumnal ring forms
5-6	7	7	(1) Few aestivo-autumnal ring forms (2) Many aestivo-autumnal ring forms, few crescents (3) Few aestivo-autumnal ring forms, one crescent (4) Few aestivo-autumnal ring forms (5) Ditto (6) Quartan gametocytes and small forms (7) Aestivo-autumnal ring forms
6-7	1	1	(1) A few tertian parasites
7-8	2	2	(1) Aestivo-autumnal ring forms (2) Ditto, few crescents
8-9	2	2	(1) Many quartan gametocytes, few ring forms (2) Few aestivo-autumnal ring forms
9-10	0	0	
10+	5	3	(1) Very few aestivo-autumnal ring forms (2) A few half-grown quartan parasites (3) Ring forms, large quartan forms, and quartan sporocytes
	45	38	

1. See Dutton, *Preliminary Note upon a Trypanosome in the Blood of Man. Thompson Yates Laboratory Reports*, vol. IV., pt. II. Liverpool, 1902.

Presence of the Malaria Parasite in its Definitive Host

Mosquitoes of the *Anopheles* genus were collected for examination from the soldiers' quarters and brought to me by an orderly from time to time in small batches; these were kept from one to three days, to allow of the digestion of the last meal of blood, and then dissected. Out of twenty-seven complete dissections, three mosquitoes were found infected; two of these had zygotes in the stomach wall, three in one and two in the other, from six to ten days old, variety undetermined. In the other infected mosquito, sporozoids were found in the salivary glands, principally in the middle lobes. Out of a dozen mosquitoes (*Anopheles*) caught in the hospital, chiefly from the West Indian soldiers' ward, two were infected. A few zygotes about three days old were found in the stomach in both cases, and were identified as *Haemamoeba malariae*; these two mosquitoes were caught in the dispenser's (native) net three days previously. An examination of his blood was made, but no parasites were detected; he had previously had no symptoms of malaria. It is very probable that these mosquitoes were infected in the town, and not from the soldiers in the barracks or hospital. To obtain *Anopheles* from these places it was necessary to visit the barracks just as dawn appeared, 6 a.m., when they were found on the walls, just over the beds of each soldier; during the day I was never able to detect an *Anopheles* mosquito in this room; they were probably all driven out by the disturbance of rolling up kit, etc., in the morning. The *Anopheles* examined were all *Anopheles costalis*, except three *Anopheles pharoensis*, which were negative.

At the Cape the natives brought me a good number of mosquitoes collected from their huts; nearly all collected in this way were of the *Anopheles* genera, including *Anopheles costalis* and *Anopheles funestus*, the number of the latter greatly predominating.

Twenty-four complete dissections were made, two *Anopheles funestus* being found infected; in one the salivary gland contained sporozoids in large quantities, and in the other four medium-sized zygotes with three empty capsules were present on the stomach wall. Unfortunately, many mosquitoes brought back to Bathurst had died on the way, and were unfit for dissection on arrival.

Other Haemamoebae.—The nature of the expedition did not permit of any extensive investigation on the distribution of other *Haemamoebidae* in the Gambia, still a few animals were examined.

The common yellow and green African canary was universally infected with *Haemamoeba danilewskii* (Halteridium); some tame pigeons from the various factories also showed this parasite in their blood, and also a few birds shot in the bush.

Haemamoeba relicta (Prateosoma) was never found; but the number of birds examined was not sufficient to form an opinion as to the absence of this parasite from the Gambia.

IV. BREEDING-PLACES OF MOSQUITOES IN BATHURST

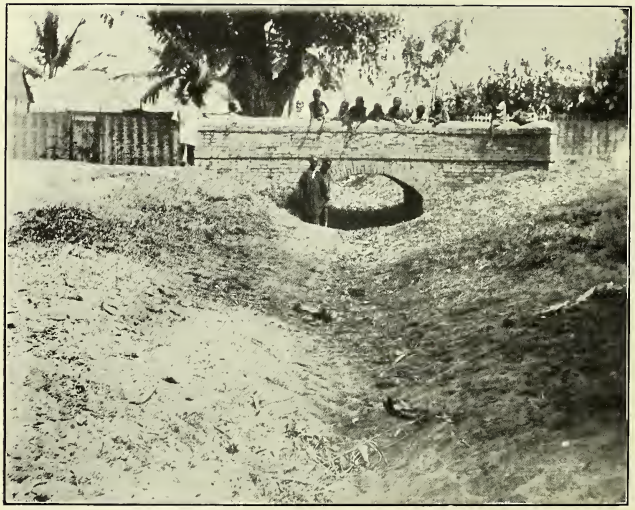
The various breeding-places of mosquitoes which occur in Bathurst can be very suitably grouped under two heads, namely, natural and artificial. The latter are by far the most numerous and important, as many of them occur throughout the wet and dry season, while for at least six months of the year the natural breeding-places have ceased to exist. The following are the chief artificial breeding-places of mosquitoes in Bathurst:—

1.—*Canoes, boats, lighters, and cutters on the foreshore.* The making of boats appears to be a rather extensive industry amongst the natives at Bathurst ; the boats are constructed or repaired on the foreshore, in front of Wellington Street. There is always a large number of these boats lying on the beach ; some of them have been found unfit for repairs and are discarded, others are waiting their turn, it may be, for some weeks, and still others are present waiting to be launched. These canoes and boats collect rain-water, and in the larger boats the amount of water present is very considerable, and often lasts not only between the showers but for a long time after the rains have ceased. In one old boat I found water present four weeks after the last shower in October. In many of the boats the water was from one to two feet deep. On examination, as would naturally be expected, I found these boats almost universally infested with mosquito larvae. **From a rough estimation I made I calculated that each of these boats would produce two thousand mosquitoes per week ; fifty boats of all kinds producing this quantity of mosquitoes is a total of one hundred thousand insects per week distributed into the town.** It will be seen, therefore, that these boats provide excellent and very extensive breeding-places for mosquitoes throughout the wet season and for a portion of the dry. There is no doubt that the houses in Wellington Street derive most of their mosquitoes from these artificial breeding-grounds. The mosquitoes found breeding in these boats were, in order of frequency :—

Stegomyia fasciata
Anopheles costalis
Culex duttoni
Stegomyia albocephala
Culex tigripens

2.—*The Street Drains.* The street drains carrying off surface water have been described as running down the centres of the streets. They can conveniently be arranged under three heads with regard to their capacity for acting as suitable breeding-places for mosquitoes.

(*a*) The large main channels (three to six feet deep by six feet wide), which open into the river at the sluice gates. These drains occur in Hill Street, Alglesea Street, Picton Street, Blucher Street, and the large drain on one



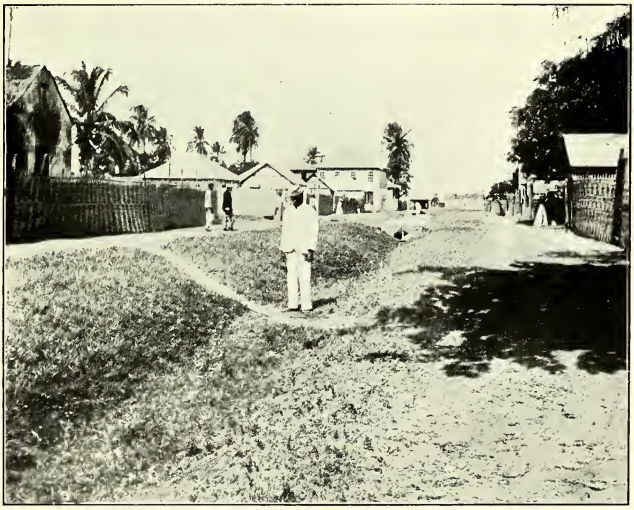
Llewellyn Street drain, near Clifton Road, in the dry season. This drain, being constructed in sand, with no protection against falling in of the sides, allows of the formation of suitable puddles for breeding mosquitoes. *Anopheles costalis* principally breed in this drain. Water collects underneath the low bridges crossing the drain, in which many mosquitoes are found at the end of the wet season.

side of McCarthy's Square. In these drains I was never able to find mosquito larvae during the months of October, November, and the first part of December, although surface water from one-half to three feet deep was always present in them. There is no doubt that the absence of larvae in these drains was due to the large quantities of small fish which are continually swimming up and down the channels in small shoals of from thirty to sixty. The sides of the drains being perfectly smooth, no protection is afforded to the larvae. As the dry weather sets in the water gradually sinks lower and lower in the drains, until water is only present for a distance of twelve to fifteen yards from the sluice gates. This amount of water is present probably throughout the dry season, as it is tidal water which oozes into the drains through the sluice gates. In the process of drying-up, the fish die out or are killed when the drains are cleaned at the end of the wet season. The disappearance of the fish was followed by the presence of mosquito larvae in the water. At the end of December and in January I found innumerable quantities of mosquito larvae in the water in Hill Street drain, near the sluice gates, later, in Alglesea Street drain, and, just before I came away, in Picton Street and Blucher Street drains. These mosquitoes were principally *Culex thalassios*, *Culex duttoni*, and a few *Anopheles costalis*.

(*b*) Shallower drains, made of brick or stone, either partly cemented or not at all, varying from one to one-and-a-half feet deep ; these drains either discharge at right angles to the larger drains or are continuations of them into the centre of the town. They vary with regard to their fitness to act as breeding-places of mosquitoes according to the seasons of the year. In the wet months they are probably free from mosquito larvae, owing to the amount of water passing along them, and thus the small fish would be able to swim up from the main drain. At the beginning of the rains and end of the wet season mosquitoes can breed in them. In October and November I found that after the rain small pools of water collected, owing to the unevenness of the cemented bed of the drain, after the main mass of water had passed away. This condition occurs in the drains of the following streets : Lemon, Hagan, and the town end of Blucher and Picton Streets. The other condition present in these drains, and of more importance than the irregularities in the bed of the drains, is the fact that many of these shallow drains are not completely lined with cement, so that they allow the ground water to percolate into them. This water I found formed a very slow stream along the course of the drain, about one-half to one inch in depth, and was very

suitable for the development of mosquito larvae, which were present here in fair numbers, chiefly larvae of *Anopheles costalis*. This condition obtained, when I arrived in Bathurst, and lasted through the months of October and November, that is, until the level of the ground water had sunk below the bed of the drain. The streets in which these conditions occurred are Dobson Street, Hagan Street, Blucher Street, Hill Street, part of Lemon and Buckle Streets.

(*c*) The other kind of drain occurring in Bathurst is that which has been described as a trench dug along the centre of the streets. These drains either communicate with the big drains or discharge directly into the swamps. It was pointed out that the depth of these drains vary, and that they often are converted into a series of pools by rubbish and sand either thrown into them or by natives walking across. I found these drains to be almost universally infested with mosquito larvae, which occurred in great quantities along their course, and were for the most part all of the genus *Anopheles* ; only very occasionally did I find the *Culex* type of larvae in any amount. The small fish, which have been mentioned as being so beneficial in keeping the larger-made drains free from mosquito larvae, though occurring also in many of the grass-choked drains, are here at a disadvantage, the larvae being to a great extent protected by the grass and sticks amongst which they can hide ; also pools cut off from the main masses of water occur in which fish cannot gain entrance. **These drains supply Bathurst with the majority of its mosquitoes during the months of September, October, and November.** They occur in the following streets : Fitzgerald Street, the drain runs along the centre of this street from the corner of Kent Street to Box Bar, where it is supposed to empty itself by a channel running down Lovel Place, entering the main drain leading into a swamp. The uselessness of these stretches as a whole are well illustrated by this drain, where I found the outlet completely blocked up with sand and rubbish, so that water would of necessity flow over Lovel Street to get into the swamp, and small fish for this reason also could not possibly gain entrance. Further, the drain itself had been converted into a series of long pools by the natives walking across, carrying with them sand, etc., and, lastly, the thick, rank grass growing in the bed of the drain, together with its naturally small fall, tends to retain the water in it. This drain is bricked across by two or three low, brick arches at the street crossings. Underneath these arches the bed of the drain dips, so that water collects in considerable quantity, which I found contained many *Anopheles* larvae ; also, in the course of



One of the central grass-clogged drains at Bathurst in the dry season at a spot where the course of the drain is obliterated by reason of natives walking across ; at the end of the wet season this drain is a series of long puddles breeding large quantities of *Anopheles*.

the drain a cemented catch-pit occurs, one foot in depth ; this I also found afforded an excellent place for mosquito larvae. A few other drains in a similar condition to the one described above must be specially mentioned. Commencing at Government House and running behind the Hospital and Telegraph Station is a rather deep drain, which takes the water from a small swamp in this region, discharging into Box Bar by two smaller drains crossing Clifton Road and running through Portuguese Town. In these drains mosquito larvae are very abundant until the end of November, and especially was this the case in the two smaller drains. One of these small drains crosses Clifton Road at the back of the Hospital ; being dug out of pure sand its bed naturally was dammed up by the falling in of the sides of the drain. In the dry season for this reason also the drain becomes practically obliterated. The other drains crossing Clifton Road, nearer the Cemetery, were also converted into a series of pools by the falling in of sand and rubbish. On my arrival, and up to the end of November, these two drains swarmed with mosquito larvae ; from a rough estimation I made during these months I calculated that one larva was present in every four square inches of surface water. These two drains were five hundred feet long, and the water in them on an average was two feet across. From these data one is able to calculate approximately the number of larvae occurring in the drain, and, also, the number of mosquitoes issuing into the town per week from them.

The following are some of the principal streets in which the drains occur :—

Long Street, Grant Street, New Street, Allan Street, Kent Street, Clarkson Street, Dobson Street, Perseverance Street, Prometheus Street, the shore end of Buckle Street, Lemon Street, Picton Street, the town end of Lancaster Street, the swamp end of Hill Street.

In some of these streets the earth dug out to form the drain has been piled up on either side of it, so that the surface of the street falls away from the drain. These grass-overgrown ditches also occur around some of the native compounds in New Town, on the south side of Box Bar, on three sides of McCarthy's Square, and on either side of Clifton Road, bordering Portuguese Town. These drains are certainly to be condemned ; even after heavy rains they appear to allow very little of the surface water to pass along them. Dr. Forde informed me that he has observed very little current in these drains after a heavy shower, and I have made a similar observation. They then collect the rain-water, which stagnates and becomes foul, and only disappears when the level of the ground water sinks below the bed of the ground, that is about two months after the rains. They have been shown to be often

converted into a series of pools by the pouring in of sand, and are often blocked at their outlets in a similar manner, so that fish cannot gain entrance. They thus form excellent breeding-grounds for mosquitoes, and, as I have shown, especially for the malaria-bearing variety (*Anopheles*). The species of mosquitoes found in the drains of Bathurst in order of frequency are :—

Anopheles costalis.
Culex thalassios (in drains containing tidal water).
Culex hirsutipalpis.
Culex duttoni.

3.—*Wells.* During the month of October I found that the wells of Bathurst were not a fruitful source for mosquitoes, though larvae were present in some of them ; still, as a whole, they did not provide extensive breeding-places. After the rains had ceased and as less and less water was to be found in the drains and swamps I observed that mosquito larvae occurred more frequently in the wells. The public wells, some fourteen in all, were examined at various times during October, November, December, and January ; in only one (Lancaster Street) were mosquito larvae found. This well had become foul, chiefly from rubbish thrown into it, and very soon after mosquito larvae swarmed in the water. The native population almost universally obtained drinking water from the public wells, and water is thus being drawn from these wells practically all day long. It would appear from this constant disturbance of the water that these wells were not suitable breeding-places, as I found that in many similar wells in private compounds in which the water was equally good, though less frequently drawn, mosquito larvae were easily obtained. Fifty-five large private wells were examined, occurring in compounds throughout the town ; it was found that those wells which had good covers were almost free from mosquito larvae, while all the others contained larvae in quantities depending on the frequency with which water was drawn from them. The small shallow tub wells occurring in large quantities all over the town were found to contain mosquito larvae, chiefly of the *Culex* kind, in sixty per cent. of those examined during the month of October. It was also noticed that when one of these wells became foul, and from this cause discarded, the larvae occurred in greater abundance ; not a few such tub wells exist throughout the town. It was also noticed how very rapidly the larvae sank to the bottom of the well on the slightest disturbance of the water. All the wells, both public and private, were re-examined systematically in the latter part of December and January by the Sanitary Inspector with the object of determining the percentage in which mosquito larvae occurred. The result is given in the following table up to the time of my departure from Bathurst ; this includes nearly all the public and private wells, and probably about two-thirds of the small tub wells.

	No. Examined	No. of Wells covered	Presence of *Anopheles* larvae	*Anopheles* and *Culex* type of larvae	*Culex* type of larvae
Tub wells ...	217	—	—	8	198
Stone wells—					
Public ...	14	1	—	1	—
Private ...	55	13	1	8	35

From the above table it will be seen that over ninety per cent. of the small tub wells already examined were breeding mosquitoes. With regard to the large private wells those in which larvae were found were generally the ones improperly covered. In this connexion it is interesting to record the examination of a large stone well in the yard at the Police Station, which was extremely well covered in, the only entrance as far as one could detect on superficial examination was the small wire gauze lid. In the early part of my stay in Bathurst I had not detected any mosquitoes in the water, in December this well became foul ; it was emptied and cleaned, but afterwards the water was worse than ever, having a very strong smell ; the contamination was very probably due to a leaking midden in the neighbourhood. Orders were then given that no water was to be taken from the well, and the small lid was locked. Before the filling in of this well was accomplished I examined this well and found mosquito larvae were present in it, and many young mosquitoes dead on the surface of the water. On closer examination of the well I discovered two small holes between the stone rim and wooden cover. These two holes were the only means by which mosquitoes could gain entrance into the well to lay their eggs, but the young mosquitoes apparently had failed to detect these exits and had died in their endeavours to get out through the wire gauze of the lid in the cover. It will be seen how important it is for wells to have a perfectly fitting cover. The mosquitoes which breed in the wells at Bathurst during the latter part of the year are :

Anopheles costalis (chiefly in the large built wells)
Culex fatigans
Stegomyia fasciata
Culex tigripes
Culex duttoni

Breeding-Places Occurring Round Houses and in Compounds

The number of mosquito breeding-places present in compounds was found to vary with the social position of the occupier. In small compounds of the poorer natives, where one or two huts were present, no breeding-places were found. These natives had no discarded bottles, etc., in which water could collect, nor were wells or tubs or any article for the storage of water present, sufficient water for the day being drawn from one of the public wells. These compounds were exceedingly clean and tidy, and no mosquitoes were found breeding in them. Excepting these, breeding-places were found and increased in extent and number in proportion to the wealth and position of the occupier of the compound, reaching a maximum on the premises of the larger traders (natives and white), where innumerable facilities for the development of mosquitoes were afforded. These breeding-places included all those domestic articles which are capable of containing a small quantity of water after showers lasting over a week without being dried up, or are not dried up between the frequent showers in the wet season. Such articles found were broken bottles, either stuck on a wall or scattered over the compounds, iron pots, old calabashes, tin-lined packing cases, cocoanut husks, fowl troughs, and old tins of all sorts. There was found an extraordinary amount of such-like rubbish in some of the factory compounds, the more specialized breeding-places included tubs, used for the storage of rain-water or as wash tubs for bottles, or in which water was placed for the preservation of the tub. Large barrels in which fibres were soaked, garden tubs in which water was stored for gardening purposes, old iron boilers for the collection of rain-water, improperly covered rain-tanks formed other breeding-places. In some of the factories a small gutter six inches across by four feet deep is let into the cemented floor of the yard around the ground-nut store house. This gutter is kept full of water to prevent the entrance of the ground-nut insect into the store. These gutters swarmed with mosquito larvae. In some yards a small channel runs down the centre to drain off rain-water, and is generally covered over with a board. It was found that some of these had become clogged up at intervals with sand and rubbish, so that small pools of water collected along their course; these pools acted as breeding-places for mosquitoes. **An account of an examination of one of the larger European factories will illustrate to what extent mosquitoes are bred by the white man in the tropics on his own premises. In the factory yard were six barrels containing water, in some the water was very foul; in the garden were seventeen tubs containing water for gardening purposes, and besides this number of tubs there were eight small wells, all uncovered. In all these articles mosquito larvae were present; in**

the barrels in the yard the water swarmed with *Culex* and *Stegomyia* larvae, and in the wells and tubs in the garden the larvae of *Anopheles* and *Culex* were found in all of them in good numbers. Besides these breeding-places there were many domestic articles scattered about in odd corners of the yard, which in the wet season would also have acted as breeding-places.

The Species of Mosquitoes Found in Compounds

It was observed that larvae of *A. costalis* were frequently found in rain-tubs and smaller articles containing water. Though many of these larvae may have been originally transferred to some of these articles along with the water drawn from the well, yet the occurrence of batches of larvae of the same age and in fair numbers would tend to show that this species of mosquito avails itself of these small collections of water in which to breed.

Stegomyia fasciata, in tubs and old bottles, etc.
Culex fatigans „ „ especially when the water was foul
A. costalis, tubs and barrels
Culex duttoni
Culex hirsutipalpis
Stegomyia pagens (rare), in ground-nut gutters

The wash-tubs, garden-tubs, wells, and rain-barrels occurring in compounds form the chief source of mosquito in Bathurst for at least six months of the dry season, when all other breeding-places, artificial and natural, have ceased to exist.

Natural Breeding-Places for Mosquitoes in Bathurst

The natural breeding-places for mosquitoes in Bathurst occur for the most part in the swampy districts, namely, Box Bar, Half Die, and the small swamp behind the Hospital; a few natural hollows in some of the streets, more especially those bordering on the swamps, collect rain-water, in which mosquitoes breed.

Box Bar. In the wet season this swamp is covered by a considerable mass of water, which encroaches on to New Town and Portuguese Town and into the centre of Bathurst at Albion Place, the streets in these neighbourhoods being flooded at this season of the year; how far this swamp acts as a breeding-place for mosquitoes in the height of the wet season (July and August) I cannot say definitely, but judging

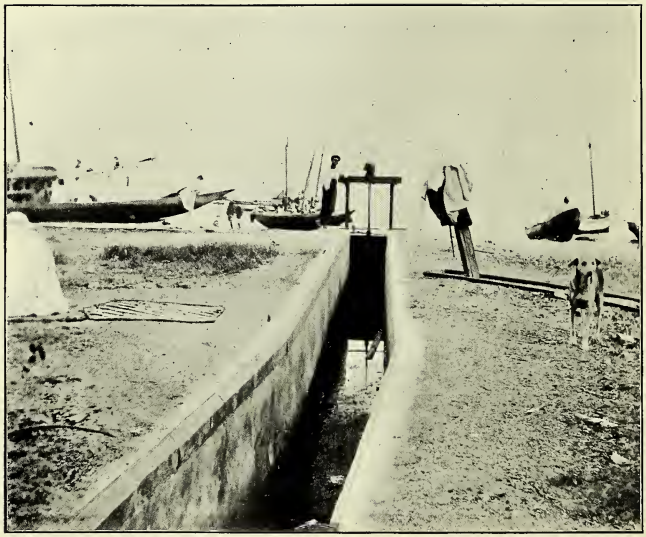
from the conditions which obtain at the end of the wet season, when I personally examined the swamp, I surmised that puddles are formed in the natural hollows of the streets all along the margins of the swamp, namely, Albion Place, Perseverance Street, etc. ; indeed I found, on arriving at Bathurst, remains of puddles in these streets ; some were dried up, others still contained a little water, in which *Anopheles* larvae were present. Box Bar swamp presented some interesting features during the months of October and November. A long, partially constructed central channel runs the length of the swamp, opening by means of double sluice gates into the Oyster Creek at the back of the town. This channel contains a large quantity of water, which overflows on to the swamp after heavy rains. On either side of this channel the land gradually rises one to three feet to Portuguese Town on the one side and New Town on the other ; it is covered with grass and a few low bushes. This land has a very uneven surface ; there are very many hollows and depressions occurring at intervals amongst the grass, and also not a few large round holes three to four yards across, which may have been formed by the natives in obtaining sand ; also, on the borders of the swamp, especially around New Town, trenches occur choked with grass. Lastly, innumerable crab holes are present everywhere, and on to the surface old tins and calabashes are thrown. In the central mass of water I was never able to obtain mosquito larvae, undoubtedly owing to the enormous quantities of small fish which are always present in the water. But in October and November the hollows and depressions mentioned above as occurring amongst the grass contained water, which was cut off from the main channel, and thus unable to drain away, nor could small fish gain entrance ; it was thus to be expected that these pools should contain innumerable mosquito larvae. Three large pools in close relation to this swamp, situated together near the cemetery, must be specially mentioned ; these pools measured twenty to twenty-five feet across, and contained water in December, when the swamp pools proper had completely dried up ; they were used then for watering cattle. As Box Bar swamp dried up these pools became more and more infested with mosquito larvae, though one of them remained free for some time. In it the water was comparatively sweeter than the other two, and small fish were present. As the dry season advanced the water in these pools became exceedingly foul, and enormous numbers of larvae, chiefly *Anopheles*, were found. A long, narrow pool occurs in this neighbourhood, along the side of the cemetery ; this pool communicated with the creek, and is flushed with tidal water ; though the water present in it was foul, and had a distinctly unpleasant smell, no mosquitoes were found breeding in it.

Half Die. This swampy district is drained in a similar manner to Box Bar by means of a central channel opening into the creek by sluice gates. No mosquitoes were ever found breeding in the central mass of water. The swampy surface is much more level than Box Bar, and very little grass is present. Native huts are built close up to the margin of this swamp, practically on all sides, and it is in their compounds

and in the adjoining streets, in which depressions either natural or dug out by the natives occur, in which mosquitoes breed. In these compounds, also, I found many old crab holes containing larvae. Owing to the comparative evenness of the surface, pools formed in this neighbourhood cannot exist for long after the rains have ceased ; by the middle of November there were only one or two natural breeding places to be found. The level of this swamp is being rapidly raised by the deposition of sand taken from the beach ; already the area which has been completed has proved a success. The native compounds built on it were comparatively free from water during the rainy season last year. The remaining swamp to be mentioned is a small one extending from the back of Government House to just beyond the telegraph station, and is limited on the town side by Picton Road. In this swamp water collects in the rainy season and lasts for some time after the rains have ceased, especially in the drain running down its centre which has been previously described ; pools and depressions also occur amongst the grass. This swamp supplies Government House, the Hospital, and other European quarters in this neighbourhood with a considerable number of mosquitoes. The mosquitoes found breeding in the above swamps were in order of frequency : *A. costalis* (the larvae of this mosquito were found in disused crab holes containing water on several occasions, principally in Half Die swamp), *Culex halassios*, *Culex duttoni*, *Culex tigripes*, *A. pharoensis* (rare), *Culex euclastos* (rare).

The swamps described above are not flushed by tidal water owing to the low wall which surrounds the town in their neighbourhood, and also because the sluice gates are only opened at ebb tide ; still a little tidal water gains entrance into the main channel by leaking through the gates.

There is a considerable variation in the number of breeding-places in Bathurst according to the season of the year. In October, when I landed there, the rainy season was rapidly drawing to a close, only a few heavy showers occurred at the beginning of the month. Altogether there was 3·81 inches rainfall. At the beginning of this month all the breeding-places described above were present, at the end of the month practically all the natural and many of the artificial (drains and boats) were dried up. Accompanying this drying up of the breeding-places there was a slight diminution of mosquitoes in some parts of the town (Government House, Hospital, Telegraph Station), but no marked diminution in factory compounds or native quarters. From November onwards, until the commencement of the rains at the beginning of June, the only places in which mosquitoes can breed are wells, tubs, and other articles for the storage of water in compounds, in the tidal water in some of the main drains near the sluice gates, chiefly in Wellington Street, and in the three pools near the cemetery. An examination of the mangrove swamp at the back of the town was made on several occasions, but no breeding-places were found, though some puddles were present which appeared to be suitable. It is very probable that the absence of breeding-places in the mangrove swamp is due to the ebb and flow of the tide and the presence of fish.



The termination of street drain at sluice gate; in the dry season *tidal water* percolates into the drain through the sluice gate; in this water many mosquitoes breed, more especially is this the breeding place for *Culex thalassios*. THEO.

Action of Tidal Water on Mosquitoes

Experiments were undertaken to see how far mosquito larvae would thrive in tidal water; larvae of *A. costalis* of various sizes were taken and were placed in tidal water in large glass jars, and supplied with food. Various percentages of salt water taken from the beach at high tide were added, at the same time control batches of similar larvae were kept in vessels containing the water in which they were breeding. It was found that many of the young and medium-sized larvae died in six to eight hours in the jars containing seventy-five per cent. of sea water, below this percentage they remained alive.

In one experiment in which larvae were placed in undiluted tidal water, one large larva remained alive and changed into a pupa in three days after the experiment started. A garden tub in which mosquitoes had been breeding was emptied and cleaned, and sea water, taken as the tide was coming in, placed in it, the other tubs in the garden being covered with mosquito netting. In four days afterwards a batch of small *Anopheles* larvae was discovered in the water, which subsequently hatched out into adult mosquitoes (*A. costalis*) seven days later. This experiment was repeated with the result that first eggs of *Anopheles* and also *Culex* appeared in one or two days after the tidal water had been placed in the tub, and subsequently adult insects hatched out from them. **From these experiments it would thus appear that certain kinds of mosquitoes can breed in tidal water** if it is not disturbed, and subsequently when the dry season had fully set in, I found larvae in suitable tidal pools, namely, as I have already mentioned, in the drains near the sluice gates in which tidal water had soaked in through the gates. In this water, which contained 1038·5 parts of chlorine per 100,000 parts, I found a few larvae of *A. costalis* and large numbers of *Culex halassios*. On another occasion, in December, I found these mosquitoes breeding in a small hole from which shells had been taken, close to the edge of the water at the mouth of Oyster Creek. The *Culex* were subsequently hatched out from this tidal water, but the *Anopheles* larvae were nearly all infested with a fungus (not identified) which gave them a woolly appearance, and I failed to hatch out any of them. I observed *A. costalis* breeding in a similar salt-water pool during a period in which neap tides occurred. The tidal water in an arm of the central channel in Box Bar, running from the sluice gates to the cemetery, had become converted into a series of small pools by partial evaporation of the water, though at every tide some water leaks through the sluice gates into this channel, but during this period it was not sufficient to replenish this small branch drain. *Anopheles* larvae were found in great numbers in these pools. It is interesting to note, also, that at this time two of the largest pools which were situated close by, and have been described as swarming with mosquito larvae, had been filled in with sand. Samples of water taken from various parts of the town were examined for the amount of chlorine present in them, the result is given in the following table.

Sample of Water	Chlorine per 100,000 parts	Chlorine expressed as percentage of NaCl
1. Public well, New Town, no mosquitoes present in water	161·2	·265
2. Public well, Lancaster Street, water rather foul, *Anopheles* larvae present in numbers	1148·0	1·89
3. Public well in Clifton Road, behind Hospital, no larvae present	186·0	0·3
4. Water (tidal) found in drain near sluice gate, Blucher Street, *A. costalis* and large quantities of *C. halassios* present	1038·5	1·71
5. Small well in private garden, *Culex* present, few only...	27·9	0·04
6. Small well in native compound, Victoria Street, *Culex* larvae present	1145·0	1·88

Mosquitoes Present in the Gambia

The commonest mosquitoes met with in Bathurst were *Stegomyia fasciata* and *A. costalis*. After these may be mentioned *Culex fatigans*, *Culex duttoni*, *Culex halassios*; the latter, a new species, was especially frequent in December and January, and bred in the tidal pools of water as described above. While in Bathurst I never saw specimens of *A. funestus*. Out of a series of *Anopheles* which had been bred, or captured in various parts of the town, Mr. Theobald has failed to detect one; on the other hand, at Baia and McCarthy Island, in the Hinterland, I did not obtain a single *A. costalis*; here all the *Anopheles* caught were the small *A. funestus* and its varieties. At Baia, out of two hundred mosquitoes brought to me by natives, all were *A. funestus* except one; these mosquitoes could be caught at any time of the day in the native huts, they were found resting on the wall, some had evidently fed not many hours previously; the ovaries were in all stages of development. At McCarthy Island I found, at 1 p.m., a great many *A. funestus* on the walls of a room in Government House in which a European slept. No other kind of mosquito was present. At Baia and McCarthy Island, in December, when everything is dried up, the river and a few marshes were the only available breeding-places. At Baia the river was three miles away from the town, and the only marsh near was two miles away. The only breeding-place in the native town was an old disused well, which was found to be thirty-four feet deep; at this depth only *Culex* larvae were found in the water. At McCarthy Island I never found mosquito larvae in the river, but in a swamp half-a-mile away from the town they occurred in great numbers. At the Cape, where a similar marsh to the one on McCarthy Island occurred, *A. funestus* was the chief mosquito found in the native town; but here *A. costalis* was also present in

small quantities. The specimens obtained were caught chiefly in the European compounds. At the Cape a few artificial breeding-places were found in compounds. It would appear then that *A. funestus* and its varieties are rural mosquitoes, and require rather special breeding-places, while *A. costalis* is essentially a town-bred mosquito, and capable of utilizing any small collections of water for breeding purposes. At Bathurst I obtained one single specimen of the genus *Panoplites*, which was caught in the prison (*P. uniformis*, THEOBALD). This species of mosquito was never found breeding around Bathurst, and these mosquitoes were only seen in the marshes at McCarthy Island and Baia. Here they occurred in considerable numbers, and attacked natives and whites crossing the marsh at all times of the day in a very vicious manner. The observation of DURHAM and others with regard to *Stegomyia fasciata* was fully confirmed at Bathurst ; these mosquitoes only bite during the day, more especially in the early part of the afternoon. None of this species were collected in mosquito nets during the night. As yet we have no method by which any approach to the exact estimation of the number of mosquitoes in a district can be ascertained, although a rough estimation may be got from the number and extent of the breeding-places ; also the presence of mosquitoes at times when no breeding-places can be found, can be demonstrated by the construction of artificial pools as described by the Members of the Royal Society's Malaria Commission. No reliance can be placed on the statements of the white man in Africa as to the presence, or absence, or number of mosquitoes in the district. Many men become immune to the bites of mosquitoes after a time, and on the other hand, one or two importune mosquitoes cause as much annoyance as many. With the object of obtaining some idea of the number of mosquitoes entering a house at night, I employed the mosquito net method, which was found so useful by the Members of the Liverpool Malaria Expedition to Nigeria, in detecting the presence of mosquitoes in the absence of breeding-places. The Hospital was selected as the site for the experiment, and a net free from holes was rigged up over a bed in one of the wards, in which one of the orderlies or native patients slept. The net, instead of being tucked under the mattress in the usual way, fell short of the bed clothes, a space of two to four inches being left between the edges of the bed and the bottom of the net. The net was put down every night before the sun went down. During the evening, mosquitoes obtaining entrance below after feeding would climb to the top of the net. These were collected about 6 a.m. in the morning by myself or an intelligent orderly who brought them to me. Mosquitoes failed to find exit in nets rigged up in this manner even when they have become quite lively. The result of the experiment, which is given in the following table, was carried on throughout the months of November, December, and part of January. Though this method is as yet very imperfect it might be useful and interesting to rig up a similar net in the wet season, and to compare the numbers caught at the time. During the time this experiment was

proceeding it must be remembered that all the natural breeding-places near the Hospital where completely dried up, and in the Hospital compound itself no artificial breeding-places occurred.

Mosquito Net Experiment

Date	No. present in net each day	Remarks	Date	No. present in net each day	Remarks
Nov. 1	3	1 *Culex*, 1 *A. costalis*, 1 *A. pharoensis*	Dec. 17	0	
„ 13	0		„ 18	1	*Culex*
„ 14	0		„ 19	2	*A. costalis*, *Culex*
„ 15	0		„ 20	1	*A. costalis*
„ 16	1	*Culex*	„ 21	0	
„ 17	1	*A. pharoensis*	„ 22	1	*A. costalis*
„ 18	1	*Culex*	„ 23	2	*Culex*
„ 19	3	All *Culex fatigans*	„ 24	0	
„ 20	3	*Culex*	„ 25	0	
„ 21	3	All *A. costalis*	„ 26	2	*A. costalis*
„ 22	7	3 *A. costalis*, 4 *Culex*	„ 27	7	All *A. costalis*
„ 23	1	*Anopheles*	„ 28	0	
„ 24	2	*Culex fatigans*	„ 29	4	*A. costalis*
„ 25	2	*Culex*	„ 30	3	„
„ 26	1	*A. costalis*	„ 31	1	„
„ 27 to Dec. 3		Away up river, mosquitoes not collected	Jan. 1	2	„
			„ 2	1	„
			„ 3	2	„
„ 4	0		„ 4	1	„
„ 5	0		„ 5	1	„
„ 6	0		„ 6	2	„
„ 7	3	*A. costalis*	„ 7	0	
„ 8	2	1 *A. costalis*, 1 *Culex*	„ 8	0	
„ 9	0		„ 9	0	
„ 10	0		„ 10	0	
„ 11	1	*A. costalis*	„ 11	5	1 *Culex*, 4 *A. costalis*
„ 12	0		„ 12	0	
„ 13	0		„ 13	3	*A. costalis*
„ 14	2	*A. costalis* and *C. fatigans*	„ 14	2	„
„ 15	2	*Culex*	„ 15	1	„
„ 16	2	*A. costalis*	„ 16	2	*A. costalis*, 1 *Culex*

V. PREVENTION OF MALARIAL FEVER IN THE GAMBIA—DESTRUCTION OF MOSQUITOES

Practical measures against malaria have already been briefly referred to in an earlier part of this report. It remains now to consider how far these measures are applicable to the conditions which obtain in Bathurst. For convenience we may consider them under two heads :—

1. Measures for protection of the individual—individual precautions.
2. Measures for the protection of the community.

Preventive measures, including the prophylactic use of quinine and the various methods for the prevention of bites from mosquitoes, which can be adopted by everyone in the tropics, have already been carefully described and summed up by various writers, so that little need be said here. *There is no doubt that the number of bites from the Culicidae in the tropics can be greatly diminished by the careful use of the mosquito net, and thus the risk of infection from malaria lessened. But even this simple measure, as other observers have said, is astonishingly neglected and abused in Africa, and this abuse, unfortunately, is greatest among the European traders and their clerks, where the chance of malarial infection is greatest.* It is curious to note, after very careful demonstration in the way in which the net should be used, how soon one finds the nets of the Europeans acting as mosquito traps. In Bathurst a few of the Europeans have anti-mosquito bedrooms ; they are on the whole good, but great care will be necessary to keep them free from holes, as they are made of mosquito netting ; also the 'boys' are very apt to leave the doors open during the day, thus allowing the entry of mosquitoes. I understand that Government will soon supply all the officials with a mosquito-room, and there is no doubt that with care they can be used with some measure of success. In this connexion it would be a great advantage if the ward at the hospital in which the European patients are treated were made mosquito proof. Mosquito nets over patients' beds are unsatisfactory, owing to the necessary disturbance which takes place in connexion with the treatment of the patient. Besides the precautions directed against mosquitoes, there is no doubt that exercise and fresh air helps one, and in Bathurst special facilities exist for such exercise. There is a fairly good road for cycling, driving, or riding ; and amongst games, tennis, cricket, and even football may be played. It is probable that it will be some time before the malaria mosquito investigations will be appreciated by the white man in Africa, and even when this desired result is attained, one cannot rely upon the

individual to protect himself against malaria. Therefore an important matter presents itself for consideration in each West African Colony, namely, how far can the white population be protected and to what extent can suggested measures be made applicable to the various districts and towns in the Colony? The three most important suggestions which have been put forward for this purpose (the protection of a country) are :

1. The destruction of the malaria parasite in the intermediary host (man) by means of quinine.
2. Segregation.
3. Destruction of the mosquito.

Koch first suggested the administration of quinine on a large scale, and applied it with some success to communities in German East Indies. In Africa, at Lagos, quinine is given gratuitously to the natives. This measure to be efficient must be energetically carried out, that is, each individual member of the community harbouring malaria parasites must be dosed with the drug. Neglecting the large expense it would entail this measure alone is not applicable in Bathurst, it would be difficult to carry out in an efficient manner. It would be impossible, until education has further advanced, to get the natives to submit to such treatment without using force.

In Bathurst, the valuable method of segregation is not feasible, as the town is already laid out, and good houses, occupied by Europeans, are situated in many of the streets, and surrounded by, as a rule, equally well-built native quarters ; still, in a small way, in one part of Bathurst this measure could be applied, namely, to the piece of land extending from the beach to Clifton Road, on which are situated Government House, Hospital, and other European quarters ; this area should be kept free from the native huts. The method of segregation is applied to some extent among the European Commissioners, their huts at the various native towns being built three hundred yards away from the native compounds. The segregation principle should also be adopted when new administrative quarters are built in the Colony, new bungaloes should not be erected within a distance of half-a-mile from the native quarters ; this rule should also be seriously considered by the European traders choosing a site for a new depôt.

The last method, which has been so ably advocated by Professor Ross, deals with the destruction of the mosquito by the elimination of its breeding-places. In this method the point aimed at is to reduce the number of all species of mosquitoes in certain suitable districts ; it appears to me that the town of Bathurst is especially suitable for the accomplishment of such a measure. It is situated as described on a practically isolated piece of land surrounded on nearly all sides by a broad expanse of water. The amount of land to be dealt with is comparatively small, namely, about a square mile, the surface is fairly level and sandy, readily absorbing water. In this area the breeding-places of mosquitoes are a known quantity, the artificial (those made by man) being in excess of the natural. The rainfall for a tropical country is

very small, and rain occurs only in four out of the twelve months of the year. Finally, in the dry season, as already stated, the breeding-places of mosquitoes occur only in the various yards and compounds. Excluding malaria, there are other reasons why an attempt at the destruction of mosquitoes should be undertaken in Bathurst, the close proximity of Dakar and St. Louis in the Senegal, at which places epidemics of yellow fever have broken out from time to time, is a danger to the inhabitants of Bathurst (in 1900, at Dakar and St. Louis, there were four hundred and ninety-five cases of yellow fever, with two hundred and twenty-five deaths), thus the probability of yellow fever being introduced into Bathurst from these ports by traders and others,* and its spread amongst the Europeans in this town by the means of mosquitoes is not to be disregarded. There is yet another disease very prevalent in Bathurst which is also spread by means of mosquitoes, namely, Filariasis. An examination of the blood of a number of the inhabitants revealed the presence of filarial embryos in thirty-four per cent. of those examined. Cases of Elephantiasis are frequently seen in the streets of the town. In Bathurst it is thus especially needful to diminish as far as possible the number of mosquitoes which infest the town.

In chapter IV, I have described the various mosquito breeding-places occurring in Bathurst ; here it remains to discuss the methods most suitable for their abolition.

Artificial Breeding-Places. The discarded domestic articles, including tins, bottles, calabashes, etc., must be collected and removed from all compounds in the first instance, and provision against their re-accumulation is necessary ; this might be accomplished by a systematic collection under the supervision of the Sanitary Board. The rain tanks and barrels for the storage of rain water require well-fitting covers ; such tanks should not be allowed in compounds without anti-mosquito covers, as not only do they breed mosquitoes, but the stored water soon becomes foul by dust, dirt, and insects which collect in them. Water tubs required for the soaking of fibres should be completely emptied at least once a week, and refilled with fresh water. As a further safeguard, kerosine oil should be applied to the surface of the water when the tub is refilled. Tubs for the storage of water for gardening purposes should be limited in number, and only sufficient water for the day ought to be stored in them. These tubs should be completely emptied of water by turning them upside down every day ; if this is not done a very considerable quantity of mosquito larvae are likely to remain in the small quantity of water left in the bottom of the tub. Gutters round the ground-nut stores, when filled with water, should be treated at the same time with kerosine oil, an ounce of which would probably be sufficient for each gutter.

Boats. The following methods of dealing with boats naturally suggest themselves : old boats and canoes should not be allowed to remain on the beach, such discarded boats should be broken up. Boats awaiting repairs should be turned bottom uppermost, larger boats and hulks, staying short periods on the beach, should be carefully

* See Chapter I

inspected, the rain water collected in them should be baled out as much as possible, and, in addition, kerosine oil or other culicicide should be applied, as it is impossible to bale out all the water from such boats, and even in a very small quantity of water many mosquitoes can breed; the boats on the shore should be inspected at least once a week.

Wells. There is no doubt that in Bathurst there is an excess of small tub wells out of proportion to the requirements of the natives. In the first instance, in dealing with these wells their number should be reduced; this could be accomplished by filling in these wells as they become foul (a condition of affairs which often occurs), and prohibiting the digging of new wells without the consent of the local authority. A better plan would be to do away with the majority of the native tub wells and, in their stead, to increase the number of public wells, properly covered and under the control of the sanitary authority. Dr. FORDE has devised, as a preliminary measure to control the breeding of mosquitoes in these small wells, a very ingenious cover, which also could be utilized as a cover for rain tubs and barrels. This cover consists of a large iron hoop obtained from discarded barrels, to which is fastened all round a piece of stout calico or sacking free from holes, in such a manner that a good deal of sag is left in the material. After water is obtained from the well the hoop is thrown over the mouth, and the calico catching on the rim of the well completely closes the entrance and is kept taut by the weight of the iron hoop. This cover is so simple, and, however carelessly applied, must effectually close the entrance of the tub against mosquitoes, that I think it is well worthy of extensive use in the town. Dr. FORDE had lately informed me that these covers are now being made in Bathurst, and are sold to the natives for the sum of fourpence. Another method which I believe to be feasible, and certainly applicable to the larger private wells, is to stock them with fish; indeed, I came across four wells in Bathurst in which fish were present, and in which I could never detect mosquito larvae. The fish in these wells had been obtained from one of the large drains in the town; unfortunately, I do not know the species. With regard to the large private wells, it is very essential that these should have proper anti-mosquito-proof covers.

Street Drains. It appears to be unfeasible to allow the open street drains to act as drains for subsoil as well as surface water; in fact, many of the larger drains have been well cemented to exclude sub-soil water. From the anti-mosquito point of view it is very desirable that the central street drains should only be utilized for carrying away surface water. It has been shown that when sub-soil water percolates into these drains a most suitable condition for the breeding of mosquitoes is brought about. It is therefore necessary that the bed and sides of the street drains should be well cemented. Many of the shallow drains require attention in this respect. Catchpits in the course of the drain are useless and should be abolished, and also the dips in many of the drains occurring underneath the small bridges at the corners of the streets. Frequent brushing

Raising the level of Halt Die Swamp by deposition of sand taken from the beach.

out of the drains at the close of the wet season would be helpful for the purpose of removal of the small pools of water which collect in some parts of the bed of the drain. Special care ought also to be taken to provide for the entrance of fish, which have been shown to be such excellent mosquito scavengers. The centrally situated grass-clogged drains ought to be abolished; as drains they are inefficient, and as they form the chief source of mosquitoes in Bathurst at certain times of the year, they urgently require attention; many of them could be got rid of by filling in with the earth and sand piled up on either side of these drains. Their place should be taken by superficial saucer-shaped drains. The filling in of these drains will take some little time, and it will be necessary to adopt some method in the meantime to prevent, or at least to diminish, the numerous mosquito larvae infesting them. The only feasible way will be the employment of labourers to keep the drains free from long grass and rubbish, and the intelligent application of kerosine. Also special attention should be taken to keep the mouths of these drains free from rubbish, so that small fish can gain easy entrance to them.

Natural Breeding-Places. The abolition of the breeding-places occurring in the swampy districts of Bathurst is a work which will take some time, and consists practically of raising the level of the swamps by the deposition of sand, together with a proper system of drainage. At Half Die swamp the process of filling in was being pursued with great rapidity during my stay at Bathurst, and a great portion of this area has been raised two or three feet; still there is a large area of a swampy nature in Bathurst to be treated in this manner, and until this is accomplished it will be necessary to provide some other method of ridding these districts of mosquito breeding-places. In this connexion, it must be remembered that mosquitoes do not breed in the central mass of water in the swamps, this water being disturbed by winds, the rise and fall of the tide (to some extent), and, also, it is well stocked with fish, so the mosquito breeding-places to be dealt with will be found along the borders of this water, and will vary in position according to the height of the water in the swamp.

Mention has been made of the holes, irregularities, ditches, and large pools which occur on the borders of the swamps (chiefly Box Bar swamp), and in which it was shown mosquitoes bred in great quantities. Such-like breeding-places could be dealt with by filling them up with sand—the number of them is not very great; around the borders of Box Bar, for instance, there are only about fifteen of the larger holes to be dealt with. This work could easily be accomplished during the dry season by a few labourers. During the rains special inspection should be made of the borders of the swamps, and the breeding-places found treated with kerosine or other oil; I believe that the application of kerosine in an intelligent manner would produce some good results, nor do I think the cost would be very great. In the streets bordering on the swamps, holes and irregularities occur, but more especially are they found in the native compounds in these situations, and in the rainy season, when the swamp water is high,

breed many mosquitoes. Such streets and compounds urgently require attention, and I would specially mention in this connexion Albion Place, Prescot Street, Perseverance Street, and other streets around Box Bar. The natives themselves in these districts could do a great deal by raising the level of their compounds by the deposition of sand and shells, indeed, some of the compounds have been raised in this way with beneficial effects. There is one small swamp, namely, that behind Government House and the hospital, which urgently requires filling in, because in this neighbourhood a good number of Europeans are stationed, and it is from this swamp that they obtain the majority of the mosquitoes occurring in their houses.

To carry out the above suggested measures of dealing with mosquito breeding-places in Bathurst, it will be necessary in the first instance to appoint a small permanent sanitary staff for the purpose, whose sole work would be to destroy existing breeding-places and to prevent their recurrence. The sanitary staff should be under the control of the sanitary board, and its movements directed by the colonial surgeon ; it should at least consist of one inspector having a good knowledge of the mosquito, its larva, and its breeding-places ; under him a small gang of workmen, who could easily be taught to distinguish mosquito larva, and a cart for the removal of rubbish, tins, etc., from the various compounds would be required. The men, besides this work, would be employed in filling up holes and depressions, brushing out drains, and applying culicicides when required. It is especially necessary that such an inspector should understand when and where culicicides ought to be employed. Before any systematic work is undertaken, a preliminary removal of rubbish from houses and compounds and factory yards is essential. The rubbish so collected, which consists of old tins, bottles, iron pots, etc., will be of some value, as it can be utilized to fill up hollows and pools occurring throughout the town. After this preliminary removal, the work of the sanitary inspector will be :—

1. A systematic weekly inspection of all houses and compounds, for the purpose of searching out and dealing with breeding-places and preventing the accumulation of old tins, etc.
2. Systematic inspection of the street drains and boats on the foreshore.
3. Similar systematic inspection for natural breeding-places round the margins of the swamps.

Many of the breeding-places found in this way can be immediately destroyed by the inspector by one or more of the methods described above, others more difficult to deal with would have to be reported to the colonial surgeon.

The work of the anti-mosquito staff will naturally vary according to the season of the year. The inspection of yards and compounds must necessarily go on week by week all the year round, as mosquitoes are breeding in these places at all seasons of the year. A great deal of information will have to be obtained by the preliminary inspection as to which compounds are the most productive of mosquitoes,

Preliminary filling in of a grass-clogged ditch at Bathurst with old tins, scrap iron, etc., collected from compounds in the town, the source of many mosquitoes, chiefly of the *Anopheles* genus.

and such will require special attention. The public should be encouraged to report to the inspector when the mosquitoes are troublesome in order to help on the work.

The town drains will require special attention at the beginning, and more so at the end of the wet season (October and November), and it will be probably necessary to increase the staff of workmen at these times to keep them free from larvae, especially the grass-clogged drains. In the dry season (for seven months) they need scarcely any attention, with one most important exception, viz., the main drains to the sluice gates ; in these it has been shown that sea water collects at this time of the year, and in it many mosquito larvae are found ; regular application of kerosine oil to these drains, I believe, would be the most feasible method of treatment.

In the dry season, also, no special inspection of the swamps is necessary, as they are dried up at this time, but holes and depressions which have been found to act as breeding-places in the wet season can now be filled in with sand, etc., by the workmen. The swamps will require attention like the drains, more especially at the beginning and end of the wet season, when pools are shut off from the main mass of water ; I believe it will be found that in the height of the wet season few mosquitoes breed in these swamps. At this time the swamp is practically an open sheet of water exposed to winds, and is well-stocked with fish ; it will thus probably be more necessary to pay attention to the hollows in the streets and compounds bordering these swamps.

It cannot be expected that Bathurst will be appreciably freed from mosquitoes at once, solely by the energies of the mosquito brigade, because, it must be remembered, breeding-places occur which require more special attention than others ; for example, it will probably be necessary to deal with the small private wells and boats on the foreshore by legislation : also engineering work, such as levelling streets, making proper street drains, and filling in the swamps will necessarily take some time. **Still, Bathurst, by means of the special anti-mosquito staff, can certainly be made as free from mosquitoes all the year round as it is in the height of the dry season ; and, further, there is every reason to believe that mosquitoes can be diminished in numbers to a great extent, more especially by means of the house-to-house inspection.**

VI. THE COMMENCEMENT OF THE CAMPAIGN AGAINST MOSQUITOES IN BATHURST

In the early part of November, a preliminary report upon the sources of mosquitoes in Bathurst was submitted to His Excellency the Acting Governor, H. M. Brandford-Griffith, Esq. In this report the mosquito breeding-places of Bathurst were described, and methods applicable for their extermination were discussed; it was pointed out that the inauguration of a crusade against mosquitoes in Bathurst offered every hope of success, and at the same time, it was urged that any measures adopted in this direction should be of a permanent nature, and considered part of the sanitary work of the town.

On November 5, His Excellency very kindly gave the colonial surgeon, Dr. R. M. Forde, and myself an opportunity of discussing with him the various matters referred to in the report. At this meeting I was informed of the desire on the part of the Colonial Government to enter upon a crusade against the mosquito, and to undertake the necessary work. Soon after this date the plan of campaign was arranged; Mr. Thomas, the sanitary inspector, was selected for the part of 'anti-mosquito' inspector, and received special instruction in the work; an assistant inspector was appointed to take his place for the ordinary sanitary duties. A gang of ten of the sanitary board labourers, including one head-man, was appointed for special duty, and one of the sanitary carts was set aside for the work.

It was decided, in the first instance, to remove all the old tins, pots, and other rubbish from all yards and compounds; to this end notice was posted up throughout the town, informing the people of the nature of the work and inviting their co-operation and help.

On November 18, the preliminary removal of rubbish from the various compounds began. The work was started in Wellington Street, where most of the large trading stores are situated. At the outset the progress was slow, as the process of ridding these large business premises of discarded tin boxes and bottles took some time, in fact, at some of the factories it required two days to accomplish. After Wellington Street had been depleted of rubbish the work progressed more rapidly, from many of the compounds the natives had collected their old tins and pots and placed them in readiness for the sanitary carts, though, as was to be expected, it was found that many such-like articles were left behind in odd corners.

The rubbish thus collected from the compounds was utilized to fill in a deep

trench running behind the hospital, which has been already mentioned as being an excellent breeding-place for the mosquito ; the old tins, which were well battered down, were then covered with sand from the shore.

After the removal of the rubbish from the larger compounds had been completed, a small gang of the labourers were employed in filling in two large pools near the cemetery, which were found breeding mosquitoes in great quantities ; the third pool was left for a while until it could be replaced by a well, as this pool was required for the purpose of watering cattle. Besides this work a few foul wells were filled in. *Up to my departure from the Gambia, January* 10, *three hundred and sixty-three houses and compounds had been inspected, and from them one hundred and thirty-one cart loads of old tins, pots, and other rubbish were removed, and about two hundred and thirty yards of the trench behind the hospital had been filled in.*

On the return of the governor, Sir George Denton, K.C.M.G., about the middle of December, other matters in connexion with the work were considered. It was decided that the work which had been started should be a permanent sanitary measure—*i.e.*, an inspector and sufficient labourers should be employed solely for the purpose of dealing with the destruction of mosquitoes. For this end the grant for sanitary work was increased to the extent of £200 per annum, and this annual amount was to be devoted to the work.

An ordinance was drawn up and passed by the legislative council in the early part of January, 1902. In this ordinance, which is to amend the Public Health Ordinance, 1887, powers were sought to enable the Governor in Council to make rules and regulations for various sanitary purposes. Some of the sections are of the utmost importance for the carrying on of the campaign against mosquitoes in Bathurst, because by them certain artificial breeding-places can be dealt with in a more thorough manner.

The sections relative to the anti-mosquito work include the following :—

11. *Breeding-Places for Mosquitoes*

Making provision for the removal, filling, or covering up of all drains, ditches, pools, swamps, holes, pits, depressions, cisterns, wells, tanks, barrels, tins, bottles, or broken pieces of bottles, and generally all receptacles, things, or places whatsoever, whether of a like nature to those before mentioned or otherwise, which are, or may be, capable of becoming breeding-places for mosquitoes or other noxious insects ; and for the prevention (by the imposition of suitable penalties on the occupiers or owners of the premises on which the same are found, or other persons responsible) of the occurrence, accumulation, or continuance thereof.

12. *Wells*

Prohibiting or rendering, subject to conditions, the digging of wells in private compounds, and making provision for the cleansing, repairing, building up or re-building on proper principles of wells presently existing ; also for the covering and keeping covered with wire-gauze lids, close pumps or other contrivances, as may be prescribed, of all wells whatsoever.

13. *Removal of Sand, etc.*

Preventing the removal or carrying away of any sand, shingle, rock, gravel, soil, or artificial protection from any part of the foreshore, or from any beach, bank, or public place whatsoever, without permission from some proper authority in such regulations to be indicated.

15. *Removal of Hulks*

Removing from any shores or beaches and open spaces, when thought advisable, all hulks, cutters, boats, canoes, timber, casks, rubbish, or any obstruction or objectionable article or thing whatsoever; or requiring the removal thereof by any persons judged to be responsible therefor.

17. *Inspection of Premises*

Providing for the inspection from time to time, and as often as may be thought expedient, of all lots, compounds, dwelling-houses, sheds, buildings, and premises whatsoever by such officers or persons as may be prescribed; subject to such conditions, safeguards, and requirements, whether as to obtaining an order under the hand of some Justice, the Chief Magistrate or other authority, or otherwise, as may be prescribed.

Dr. Forde informed me, in a letter dated February 17, that the removal of old pots and pans, etc., throughout the town had been completed, and that the inspector had now begun his regular weekly inspection of yards and compounds; also a gang of men had started filling in some of the grass-clogged drains, and the filling in of all large pools near the cemetery had now been accomplished.

I understand also that special sanitary regulations have been drawn up, but as yet I have not seen a copy.

REGULATIONS UNDER SECTION 2 OF THE PUBLIC HEALTH AMENDMENT ORDINANCE, 1902 (No. 1 of 1902)

I. (1) The occupier, and if no occupier, then the owner, of any lot, yard, compound, or other parcel of land whatsoever, shall fill up, or cause to be filled up, all drains, ditches, pools, holes, pits, irregularities, and depressions in the ground or surface of such lot, yard, compound, or parcel of land which may be of such a nature as to cause the accumulation or stagnation of water.

(2) No person shall, unless for building or other necessary or reasonable purposes, dig or make any drain, hole, irregularity, or depression in any portion of ground whatsover so as to cause or allow the accumulation or stagnation of water; all building and other such operations shall be conducted in such a manner as, so far as possible, to avoid causing such holes, irregularities, or depressions as aforesaid.

(3) Sand for making mortar or other building purposes shall in no case be taken out of the ground or soil of any lot or compound, but may be taken from the beach below or near low water mark.

II. (1) No person shall place on any wall or building, any bottles, or broken pieces of bottle, or other articles unless broken into small fragments so as to be incapable of containing water.

(2) The occupier, or if no occupier, then the owner of any building, or of any lot, yard, compound, or parcel of land whatsoever, shall cause all bottles, broken pieces of bottle, and other articles on or attached to such wall or building to be removed or broken into small fragments so as to be incapable of containing water.

III. The occupier, or if no occupier, then the owner of any lot, yard, compound, or parcel of land shall, on being required so to do by a notice under the hand of the Chairman of the Board of Health, cause all discarded tins, pots, bottles, calabashes, and all other discarded articles capable of containing water in or on such lot or parcel of land to be collected in readiness for removal by the carts of the Board of Health.

IV. The owner of any premises wherein there is now, or may hereafter be dug, any well, shall within thirty days after service upon him of a notice under the hand of the Chairman of the Board of Health requiring him so to do, cover such well with a wooden, wire-gauze, or other cover to the satisfaction of the Inspector of Nuisances.

V. The occupier, and if no occupier, then the owner, of any house, shed, or other building whatsoever, or of any lot, yard, compound, garden, or other parcel of land whatsoever, shall cause every cistern, tank, barrel, or other receptacle whatsoever holding or capable of holding water on such premises to be maintained in such a manner as not to be or to be capable of becoming a breeding-place for mosquitoes or other noxious insects.

VI. All hulks or boats hauled up on any beach or open space within the town of Bathurst, shall, so far as possible, be turned keel upwards; boats in course of construction or undergoing repair shall be exempt from this requirement, provided always that such construction or repairs are carried on with reasonable expedition, and the boats are not allowed to become breeding-places for mosquitoes by the accumulation of water therein.

In cases where it shall be found impracticable to turn any lighter or boat keel upwards, it shall be the duty of the owner thereof to take due and sufficient measures to the satisfaction of the Chairman of the Board of Health to prevent the accumulation of water therein.

'Boats' in this regulation shall include canoes, cutters, and any other small craft whatsoever.

VII. The owner of any bakehouse shall once in every six months cause the complete inside of such bakehouse to be whitewashed.

VIII. Section 49 of the Public Health Ordinance, 1887, shall be construed and is hereby declared to apply to the entry of premises for any purpose whatsoever connected with the due sanitation thereof and the enforcement of any requirement or prohibition in the said Ordinance or hereinafter in these Rules contained.

Any costs or expenses incurred in obtaining an order under the hand of the Chief Magistrate or of a Justice of the Peace as in the said Section provided, shall be recoverable against the occupier or owner of the premises in like manner as other costs and expenses are recoverable under Section 112 of the said Ordinance.

IX. If on the complaint of one or more residents it shall appear and be ascertained to the satisfaction of the Chief Magistrate or two Justices of the Peace that any person has been annoying such complainant or complainants or others by unreasonably, and at late hours of the night, playing upon any string, brass, or other musical instruments, or by singing, the Chief Magistrate or the two Justices aforesaid may in their discretion dismiss such offender with a warning, or if the offence appear to him or them to have been of repeated occurrence, whether before or after such warning. or attended by any aggravating circumstances whatsoever, fine such offender in such sum as they shall consider suitable, not exceeding ten shillings.

X. Canes shall not be dragged along Russell Street or Wellington Street.

XI. Any person contravening or wilfully or negligently failing to comply with any of the provisions contained in these regulations after service on him of a notice to that effect, under the hand of the Chairman of the Board of Health, shall be liable on conviction before the Chief Magistrate or two Justices of the Peace to a penalty which (save where it may be otherwise provided in the case of any particular offence) shall extend to, but not exceed, the sum of five pounds for any one offence, or in default of payment thereof to imprisonment with or without hard labour for any period not exceeding one month.

Passed in the Executive Council this Seventh day of July, 1902.

GEORGE C. DENTON, *Governor*

APPENDIX

REPORT ON A COLLECTION OF MOSQUITOES OR CULICIDAE, ETC., FROM GAMBIA, AND DESCRIPTIONS OF NEW SPECIES

By F. V. THEOBALD, M.A.

THE collection of Culicidae and other blood-sucking Diptera, made by Dr. DUTTON during his visit to Gambia, contains some three hundred Culicidae, included in the following genera : *Anopheles*,* *Stegomyia*, *Culex*, *Mansonia*, *Uranotaenia*, and *Corethra*. Altogether there are seventeen species of Culicidae as follows : three *Anopheles*, three *Stegomyia*, seven *Culex*, one *Mansonia*, and a single *Uranotaenia* and *Corethra*. There is also a distinct variety of *Anopheles costalis* and *Anopheles funestus*. Besides Culicidae, there are some specimens of Psychodidae, or Owl Midges, of the genus *Phlebotomus*, probably a new species, and several specimens of the common West African gadfly (*Tabanus dorsovitta* WALKER). A number of one of the Tsetse flies, *Glossina longipalpis* WIEDMANN var., *tachinoides*, WESTWOOD, were also taken.

This insect, closely related to the Tsetse fly (*Glossina morsitans*), is called by Dr. DUTTON the small Mangrove fly. It is very prevalent up the Gambia river, and comes on board the launches and bites viciously. It is of particular interest, as the case of Trypanosoma Dr. DUTTON found in Bathurst was in an Englishman, who was master of the Government launch, living on board, and was frequently bitten by this species of *Glossina*. It is quite possible that this species of *Glossina* acts in the same way as *G. morsitans* in the animal Tsetse disease.

The collection contains no new *Anopheles* but three distinct varities, three new species of *Culex*, and a distinct variety of a previously known one, also a new *Stegomyia* and a *Corethra*. The series of *Anopheles funestus* is most interesting, as it shows very great variation, particularly in the colour of the vein-scales and the position of the cross-veins, which I had found constant before in this species, and which I took to be of some specific value. Great variation is also to be noticed in a large series of *Culex Duttoni* (THEO) This species is of particular interest, as it serves as one of the intermediate hosts of *Filaria nocturna*. *Culex fatigans* (WIED.) was also found to act as an intermediate host of this *Haematozoon*. In a new banded proboscis species (*Culex anarmostus*) a filaria (sp. incert.) was found in the thoracic muscles. A list of the species, with notes and the descriptions of the *Stegomyia*, *Culex*, and *Corethra*, are here appended, and also a description of the varieties of previously known species.

LIST OF CULICIDAE AND OTHER DIPTERA TAKEN AND BRED BY DR. DUTTON

A. CULICIDAE.

1. *Anopheles costalis*. LOEW.
1a. *Anopheles costalis*. Var. *melas* n.v.
2. *Anopheles pharoensis*. THEOBALD.
3. *Anopheles funestus*. GILES.
3a. *Anopheles funestus*. Var. *umbrosus* n.v.
3a. *Anopheles funestus*. Var. *subumbrosus* n.v.
4. *Stegomyia fasciata*. FABRICIUS.
5. *Stegomyia sugens*. WIEDEMANN.

* The old genus *Anopheles* is now subdivided into several genera ; *costalis* comes in Pyretophorus, *pharoensis* in Cellia, and *funestus* in Myzomyia.

6. *Stegomyia albocephala.* N. sp.
7. *Culex hirsutipalpis.* Theobald.
8. *Culex annulioris.* Theobald. Var. *gambiensis.* n.v.
9. *Culex duttoni.* Theobald.
10. *Culex anarmostus.* N. sp.
11. *Culex thalassius.* N. sp.
12. *Culex tigrives.* Grandpre.
13. *Culex fatigans.* Wiedeman.
14. *Culex euclastus.* N. sp.
15. *Lasioconops poicilipes.* N. sp.
16. *Mansonia uniformis.* Theobald.
17. *Uranotaenia albocephala.* Theobald.
18. *Corethra ceratopogones.* N. sp.

B. PSYCHODIDAE.

Phlebotomus sp. ?

C. TABANIDAE

Tabanus dorsovitta. Walker.

D. GLOSSINIDAE

Glossina longipalpis. (Wied.)—var. *tachinoides.* Westwood.

CULICIDAE

I. *Anopheles costalis.* Loew

A. gambiensis. Giles

(Ent. Zeit. Berlin, 55 (1866) Loew ; Mono. Culicid. I. 157 (1901) Theo. Hand Bk. Gnats, 2nd Edit. Giles, 1902. (=*A. gambiensis.*)

A number of this species from Bathurst, many of them caught in the barracks, prison, and police quarters, Government House ; some bred from larvae obtained from a large pool sixteen to eighteen feet in diameter.

The specimens show some variation in regard to the intensity of the costal spots and leg ornamentation. One very marked melanic variety occurs, which is described below. The specimens were taken in October, November, and December. None were found at Baia or McCarthy Island. At Bathurst, Dr. Dutton only obtained *A. costalis* and a few *A. pharoensis.* Theo. This species also occurs at Cape St. Mary, seven miles from Bathurst, where there are a few artificial breeding-places. Colonel Giles has described as a distinct species a specimen of *A. costalis* sent me from Gambia by Dr. Budgett.

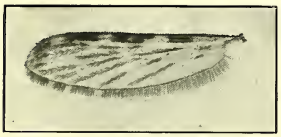
Ia. *Anopheles costalis.* Loew

Variety *melas*

Thorax dark brown to almost black, with narrow-curved pale golden scales as in the type ; palpi, with *four* pale bands, *very* narrow ; the fourth on the apex of the palpi, very scaly at their base ; the two apical bands are close together, but quite distinct. Abdomen deep black, with pale hairs, golden at the apex. Legs prominently black, spotted and banded ; forelegs with a trace of pale spots on the femora as in the type, pale spots on tibiae, and a narrow band-like spot on the metatarsi, a yellow band involving both sides of the joints at the metatarsus and first tarsal, and at the first tarsal and second tarsal ; in the mid-legs the tibiae are spotted, but the tarsal banding is not distinct, nor are the tarsi banded in the hind legs, and the tibiae and femora spots are not so well defined.

PLATE VI

WINGS OF GAMBIAN *CULICIDAE*



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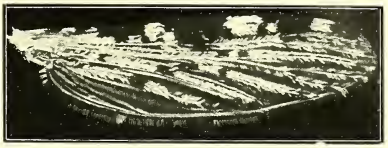

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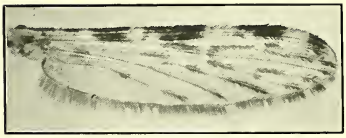

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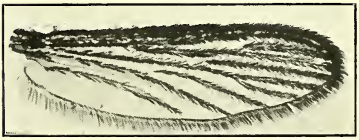

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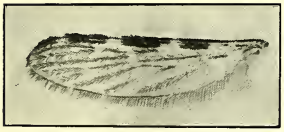

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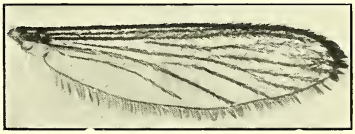

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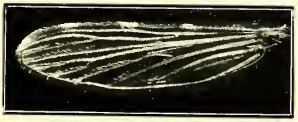

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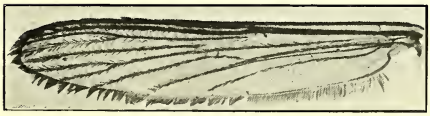
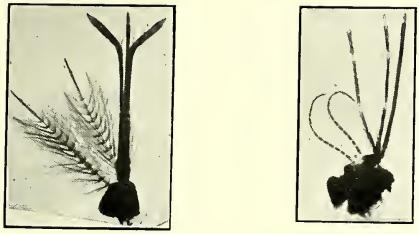


10

1. *Anopheles funestus.* Giles. ♀ var.
2. *Anopheles funestus.* ♀ Typical.
3. *Anopheles funestus.* ♂
4. *Anopheles funestus.* Var. *anisochloros.*
5. *Anopheles rhodesiensis.* Theo. ♀
6. *Anopheles pharoensis.* Theo. ♀
7. *Anopheles costalis.* Loew. ♀
8. *Culex thalassius.* N. sp.
9. *Culex euclaston.* N. sp.
10. *Anopheles rhodesiensis.* Theo. ♂

(All × nine times except No. 10 which is × twelve).



a *b*

FIG. 1

Anopheles funestus. GILES
a. Head of ♂ ; *b*. Head of ♀

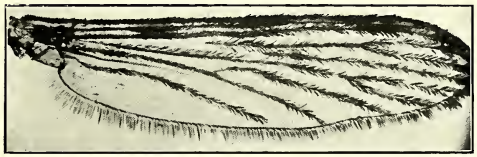


FIG. 2

Wing of ♀ *A. costalis* to show venation, not markings.
× 18

Wings with black- and yellow-scaled areas, the former predominating ; the costa is deep black, the second spot only appearing on the costa as a small, almost white, spot ; there are also two small pale spots on the costa towards the base of the wing ; on the first long vein are six pale spots, one under the white costal spot, the other arranged much as in the type, but the black areas are pronounced ; the greater part of the third long vein is pale and the second mostly dark scaled, except for the pale patch at the base of the fork and a pale patch towards the apex of its lower branch ; most of the fourth dark scaled, the lower branch of the fork having two pale patches. The fifth mostly pale scaled, but with three dark patches on the upper branch and a small one at the apex and another at the base of the lower and its stem ; sixth with three black spots ; fringe spots very indistinct. Fork-cells and cross-veins as in the type.

Length—5 mm. *Habitat*—Gambia (Dutton). *Time of capture*—December.

Observations—Described from a single female in perfect condition. It forms a very distinct melanic variety. The chief difference from a typical *A. costalis* is the absence of pale costal spots, one only reaching the actual costa, except at the base ; the whole wing field is darker, and the legs with more pronounced spotting. The markings in the first long vein are, however, typical of the species.

II. *Anopheles pharoensis*. Theobald

(*Mono. Culicid.* I, 169 (1901). Theobald)

Nine specimens (seven ♀'s and two ♂'s) of this beautiful *Anopheles* from the following localities : the barracks and prison, Bathurst, and on a marsh at the back of the town, McCarthy Island. A specimen was also hatched from a larva taken in a pool, fifteen yards across, at Box Bar. The specimens show considerable variation in size, one only measuring 5 mm. ; there is also marked variation in colour, due evidently to some containing blood. One large pool alone, some way from the town of Bathurst, acted as a breeding ground of this species. This large *Anopheles* also occurrs at Cairo, Central Africa, and in Palestine, and probably occurs all over Africa and in other parts of Asia.

III. *Anopheles funestus*. Giles

(*Mem. II, Liv. School of Trop. Med.* p. 50 (1900), Giles ; *Mono. Culicid.* I, p. 182 (1901), Theobald)

A large series of ♂'s and ♀'s of this species were taken in the following places :—Baia, the Cape, and McCarthy Island. The species occurs in native huts, and many were taken on the walls in the prison and in Government House at McCarthy Island. They were mostly taken in December. Both at Baia and McCarthy Island there were no ordinary or artificial breeding-grounds about, except here and there a large marsh. At Baia the marsh was about two miles away from the town. At Cape St. Mary, seven miles from Bathurst, this small *Anopheles* occurs in numbers, and the larvae are here found in rice swamps. This species, to some extent, resembles *A. rhodesiensis*, but can at once be told from it by the pale fringe spots and by the pale scaled areas to the wings, and the more pronounced dark patches. The white palpal bands are also, it seems, wider apart in *A. rhodesiensis*. Several of the specimens of *A. funestus* in this collection present well-marked deviations from the type. Speaking generally, the pale and dark scaled areas on the veins are not so pronounced, and the base of the fork-cells have not quite the same relative positions. In my monograph (Vol. I, p. 186) I pointed out that one of the characters separating *Funestus* from the larger *Rhodesiensis*, was the position of the cross-veins, this does not hold good, for in the *Funestus* from Gambia I find the cross-veins in some like *Funestus* as I described, in others like *Rhodesiensis*. The supernumerary and mid may be either in one line as the mid may be in advance of the supernumerary and posterior. *Rhodesiensis* has, however, *all* the vein scales dark, and the fringe unspotted, and the third long vein always dark. The wings are *always* black at the base of the costa, whereas, in most *Funestus* there is a pale costal spot near the base. *Funestus* is also smaller than *Rhodesiensis* ; the latter has so far only been sent from Mashonaland.

IIIa. *A. funestus.* Giles
Var. *Umbrosus.* Theo.

Costa black at the base, unbroken by the typical small pale spot. Veins with the dusky scales predominating ; the pale scaled areas restricted to the region of the cross-veins and base of the fork-cells and on the fifth long vein ; *the third long vein dark as in Rhodesiensis.* Wing fringe spotted as in the type, but not so prominently.

IIIb. *A. funestus.* Giles
Var. *Subumbrosus.* Theo.

Costa black at the base, unbroken by any pale spot. Dusky scales predominating, but not contrasted as in the type with the pale scaled areas. *Third long vein pale-scaled in the middle*, and pale scaled areas also on the fourth, fifth, and sixth.

IV. *Stegomyia fasciata*
(*Syst. Antl.* 36, 13, 1895. *Mono. Culic.* I, 289, 1901. Theo.)

This species is evidently common in Gambia, specimens showing great variation in size were taken in Bathurst in numbers: some in native huts, and also in European dwellings. Many seem to have been hatched out from larvae taken in a tub of well water, and others from a canoe. This species was taken in October, November, and December, and was observed feeding, as recorded elsewhere,* during the daytime (4 p.m.)

V. *Stegomyia sugens.* (Wied.)
Auss. Zweiflug Insec. 545 (1828) Wied ; *Mono. Culic.* 300 (1901) Theo.

Three ♂'s and two ♀'s taken near Bathurst. This *Stegomyia* can easily be told by the spots on the mesonotum and the pale band on the femora near the apex. Hatched out from larvae taken in ground-nut gutters during November.

VI. *Stegomyia albocephala.* N. sp.

Head covered with flat dull white scales, a small dusky patch on each side and a posterior semi-circular area of dark upright forked scales.

Thorax deep rich brown covered with scattered golden scales, showing more or less two dark eyes like spots ; scutellum with small flat white scales. Abdomen black with narrow basal white bands. Legs black, the hind tibiae with a marked apical white band.

♀. Head brown, covered with dull white flat scales, with a silvery sheen, a small patch of black scales on the border about the middle of the eyes, and dull black scales at the sides, posteriorly are black upright forked scales, giving the head a dark appearance of semicircular form, in front the upright forked scales are yellow. Proboscis, palpi, and antennae deep blackish-brown ; palpi with a trace of a pale band on its basal half, two apical joints nearly equal, with black hair-tufts and also black hairs at the apex of the anti-penultimate joint.

Thorax rich deep-brown with scattered golden narrow-curved scales, and showing in certain lights two dark eye-like patches on the ground surface ; scutellum covered with small flat shiny creamy-white scales ; pleurae brown with patches of grey scales ; metanotum deep clear brown.

Abdomen black with basal white bands which spread out laterally ; venter black with broad basal white bands ; densely clothed with long brown hairs.

Legs black, unbanded, except for a clear, rather broad, white apical band to the hind tibiae. Coxae brown, bases and venter of the femora grey, ungues of the fore and mid legs unequal, the larger uniserrated, the smaller (?) hind ungues rather long, curved, equal, and simple. Wings with the first submarginal

* *Mono. Culicidae*, Vol. i, p. 60. Theobald. (1901).

cell longer and narrower than the second posterior cell, its base nearer the base of the wing than that of the latter, its stem not quite so long as the cell ; stem of the second posterior as long as the cell ; posterior cross-vein about half its own length distant from the mid cross-vein ; halteres with yellow stem and slightly fuscous knob.

Length—4·5 mm. *Habitat.*—Gambia. *Time of appearance*—November.

Observations—Described from a single perfect male, bred by Dr. Dutton from a larva found in a canoe. This *Stegomyia* very closely resembles *Culex univittatus* mihi, and might readily be mistaken for it, on account of the conspicuous hind tibial banding, but an examination of the head and scutellum reveals flat scales only. The pale head and white shiny scutellum with the brown thorax form also striking characters.

VII. *Culex hirsutipalpis.* Theobald

(*Mono. Culicid.*, Vol. i, p. 378 (1901). Theobald)

A series of this species, which I described from some specimens from Mashonaland, were hatched out by Dr. Dutton from larvae taken in the water of ground-nut insect traps, *i.e.*, gutters full of water around the ground-nuts. Other specimens were hatched from a small dug-out pool in a rice swamp. The specimens hatched out in November and December.

The abdomen in the ♂ is much better marked than in the original type. A fresh description of the male is therefore appended.

♂. Palpi black, with four white bands, the two apical ones on the base of the last two joints narrow ; last two joints with dense tufts of hair, hairs black, except at the apex, where they are pallid ; the antipenultimate joint is also hairy down to near the first white band ; antennae banded black and grey, with deep-brown plume-hairs ; proboscis with a narrow white band.

Thorax as in ♀. Abdomen black, the second to the fifth segments with basal white bands, the sixth and seventh have the basal band spreading down each side, the last segment with a basal median white spot ; apical hairs golden ; there are also white lateral linear prolongations of the basal bands to each segment ; venter covered with pale creamy yellow scales ; legs much as in the ♀ ; fore and mid ungues unequal, both uniserrated.

Wings paler than in the ♀ ; first submarginal cell longer and narrower than the second posterior cell, the bases of the fork-cells nearly level ; stem of the first submarginal rather more than half the length of the cell ; stem of the second posterior as long as the cell ; posterior cross-vein about its own length distant from the mid cross-vein. Halteres pale, but the knob slightly tinged.

Note.—Fresh specimens are much darker than old ones. The proboscis band is narrower in the male than in the female.

VIII. *Culex annulioris.* Theobald

Var. *Gambiensis. n.v.*

(*Mono. Culicid.*, Vol. i, p. 371)

Proboscis with white band. Thorax brown with narrow-curved pale brown and grey scales on the front two-thirds ; narrow-curved black ones on the hinder third of the mesonotum ; the pale brown scales in front form more or less a distinct median line, with a narrow pale scaled line on each side and an indistinct darker broad line on each side of the narrow pale line, bounded laterally by mostly pale scales ; the scutellum, as in the type, with small black scales at the base of the mid-lobe and grey ones on the apical portion ; metanotum bright amber brown. The abdomen is like the type, but the triangular basal white spots are very indistinct, but can be detected on each segment by a few white scales when examined under the microscope.

The band on the proboscis is not quite so broad as in the type, and the stem of the first submarginal cell is very nearly half the length of the cell.

Length—5·5 mm. *Habitat*—Gambia (Dutton). *Time of capture*—January.

Observations—Described from a single female hatched from a larva taken in water in a rice field.

It resembles the type except in regard to the colour of the thoracic scales, the thorax is characteristically ornamented, under a lens the first part (two-thirds) looks ashy grey, but more or less ornamentation, as described, may be seen on careful examination, the paler anterior area is clearly marked off from the dark scaled posterior third. It is undoubtedly only a variety of the species I described as *C. annulioris*, from Salisbury, Mashonaland.

In the structural figure of this species in the *Monograph of Culicidae*, fig. 127, p. 372, vol. I, I figured the palpi as three-jointed, the apical joint being characteristically swollen and truncated, this is really the penultimate joint, the apical joint was missing, I find the apical joint is long and thick.

IX. *Culex duttoni*. Theobald

Mono. Culicid. II, p. 318 (1901). Theo.

A large series of this mosquito were taken at McCarthy Island and Bathurst Some were hatched out from larvae taken in a canoe on the foreshore, others from a tub of well water during October, November, December, and January. This is evidently a common West African insect along the coast; I have not at present seen any from inland. It was found to be one of the hosts of *Filaria nocturna* by Dr. Dutton.

This species is subject to considerable variation, both in size and in thoracic ornamentation. In some specimens brought back by Dr. Dutton the thorax shows no ornamentation at all, others have the thorax adorned as I described in the *Monograph of the Culicidae*.

X. *Culex anarmostus*. N. sp.

Thorax dark brown to brown, with two darker median parallel lines on the denuded surface, covered with pale, dull golden, narrow-curved scales, showing faint longitudinal arrangement. Proboscis with a pale creamy band. Abdomen brown, with curved basal white bands. Legs brown, with faint apical and basal pale banding. Ungues equal and simple.

♀. Head brown, with narrow-curved, pale, creamy-grey scales, brown upright forked ones and small flat white ones at the sides, and whitish curved ones round the eyes. Proboscis brown, with a median pale band very distinct beneath; palpi black, with a few white scales; clypeus black; antennae dark brown, basal joint testaceous. Thorax brown to almost black, covered with narrow golden curved scales somewhat paler behind, to some extent arranged longitudinally; scutellum pale brown, with pale narrow-curved scales; metanotum deep brown; pleurae pale brown and cinerous, with a few patches of grey scales.

Abdomen deep brown, with curved white to creamy basal bands; first segment nude, save for two median patches of black scales; border-bristles pale; venter white, with narrow apical border of brown scales.

Legs brown; femora pale ventrally, apex of tibiae white, base and apex of metatarsi and first two tarsals pale banded, also a white knee spot on the hind legs; femora and tibiae bristly; ungues equal and simple; hind tibiae about the same length as the hind metatarsi. Wings with brown scales, those on the third and fifth being the darkest; first submarginal cell longer and a little narrower than the second posterior cell, its base a little nearer the base of the wing than that of the latter, its stem half the length of the cell; stem of the second posterior about two-third the length of the cell; posterior cross-vein about its own length distant from the mid cross-vein. *The medium vein scales of the third, fifth*, and to some extent the lower branch of the second fork-cell, rather larger than in most *Culex*, and very dark. Halteres pale.

Length—4·5 mm.

Habitat—Freetown, Sierra Leone (Austen), Gambia (Dutton).

Time of capture—September (Freetown), Austen ; Gambia (in November), Dutton.

Observations—Described from a single female from Freetown ; bred from water in a drain by Mr. Austen.

A specimen sent me by Dr. Dutton, from Gambia, is evidently this species, but it is rather too damaged to say definitely. Dr. Dutton found a filarial embryo in the thoracic muscles.

XI. *Culex thalassius.* N. sp.

Proboscis with a narrow median white band. Thorax dark-brown, with narrow deep golden-brown curved scales. Abdomen dark brownish-black, with narrow basal grey bands, often absent ; penultimate segment with lateral white spots only ; pleurae very pale grey. Legs deep brown, with faint pale bands to some of the mid and fore tarsi ; apices of tibiae pale, hind legs unbanded. Bases of the fork-cells nearly level.

♀. Head deep brown, with narrow-curved, pale greyish scales and black upright forked ones ; palpi black ; proboscis black, with a narrow distinct pale band ; antennae brown ; clypeus black.

Thorax deep brown, with narrow rich brown curved scales ; scutellum brown, with narrow golden-brown curved scales, and deep brown border-bristles ; pleurae very pale and shiny grey ; metanotum deep brown. Abdomen black, with narrow basal white bands, or unbanded with traces of basal white lateral spots, venter dark, with broad basal grey bands.

Legs black, bases pallid, also venter of femora, apex of femora, and to some extent the tibia, pale ; tarsi and metatarsi with *narrow* pale basal bands, indistinct on the last two tarsi ; hind metatarsi and tibiae of about equal length.

Wings with the veins with brown scales ; fork-cells rather short, their bases about level ; the first submarginal a little longer and narrower than the second posterior, its stem a little more than half the length of the cell ; stem of the second posterior about two-thirds the length of the cell ; posterior cross-vein nearly twice its own length distant from the mid.

Length—4·5 mm. *Habitat*—Gambia. *Time of capture*—October and November.

Observations—Described from a series taken and bred by Dr. Dutton. The larvae were mostly taken in a drain of tidal water, and others from a pool in a mangrove swamp ; others from a canoe on the foreshore, and some from a pool of tidal water that had soaked through sand into a drain.

The species is very variable ; some show distinct abdominal banding, others none at all. It somewhat resembles *C. duttoni*, but is smaller, more fragile, and the legs have only faint basal banding, and the fork-cells are slightly different.

This species and *C. duttoni* come very close together, but they are certainly distinct.

XII. *Culex tigripes.* Grandpre

(*Les Moustiques.* (1901.) Grandpre. *Mono. Culicid.* II, p. 34. (1901.) Theobald)

A series of ten ♂'s and ♀'s taken at Bathurst and McCarthy Island during October. Some specimens were taken on the sides of a discarded well ; the majority were hatched from larvae taken in canoes, and also from a pool.

This large spotted-legged *Culex*, with its apical pale abdominal bands, seems to be generally distributed over Africa, but so far has not been recorded further south than Natal, as well as occurring in Mauritius and Australia. It is the species that Dr. Bancroft calls the 'long-lived mosquito.' Some of the specimens are very small, not more than 5·5 to 6 mm., others are as much as 7 mm.

XIII. *Culex fatigans*. Wied.

This common household *Culex* occurs in abundance in Bathurst, and was taken in numbers as usual indoors. Some were hatched from larvae 'from an old tin,' others 'from a well,' 'from a rain tub,' 'from water in rice field at Cape St. Mary,' 'from well in Government House with heaps of green slime.' This species seems abundant in the prison at Bathurst, and has been shown by Dr. Dutton to be the intermediate host of *Filaria nocturna*, as well as *Culex duttoni*.

They were taken in October, November, December, and January.

XIV. *Culex euclastus*. N. sp.

Head brown with grey scales, most distinct around the eyes. Thorax brown with tawny-brown scales. Abdomen brown, unbanded, with basal white lateral spots, which show dorsally on the last few segments; legs brown, unbanded, basally grey. Sixth long vein rather close to the fifth.

♀. Head dark brown with narrow-curved dull-grey scales, rather wider and paler around the eyes, and with dark upright forked-scales; proboscis and palpi dark brown: antennae dark brown, basal joint paler. Thorax brown with very small narrow-curved scales of a fawny-brown to dull brownish-grey hue, and with dark-brown bristles; scutellum paler brown with narrow-curved grey scales; metanotum brown; pleurae pallid.

Abdomen brown, unbanded, with basal white lateral spots, which are pronounced, and which show dorsally on the last few segments. Venter, brown with dull grey basal bands; border-bristles and hairs brown, except at the apex, where they are pallid; the denuded surface of the abdomen has a shiny and somewhat pale steel colour.

Legs brown, unbanded, a faint pale knee spot on the hind legs and traces of a pale apical tibial spot; bases of the legs and centre of the femora pallid; hind metatarsi about the same length as the hind tibiae; legs with a few bristles. Ungues small, equal and simple. Wings with deep-brown scales, costa very dark; first submarginal cell longer and narrower than the second posterior cell, its base very slightly nearer the base of the wing than that of the second posterior cell; its stem rather less than half the length of the cell; stem of the second posterior rather more than two-thirds the length of the cell; posterior cross-vein longer than the mid, rather more than its own length distant from it; the sixth long vein runs parallel with the fifth at its base, and is rather closer than usual to it. Halteres brown, with dense white scales.

Length—4 mm. *Habitat*—Gambia. *Time of capture*—October.

Observations—Described from two perfect ♀'s bred by Dr. Dutton from larvae taken from pools at Box Bar.

It is a very small fragile-looking species, unlike any other I have seen from Africa, and to some extent approaches *Culex nigritulus* Zett, but is very distinct in regard to thoracic scale structure and venation. The type is deposited in the British Museum (Nat. Hist.) Collection.

Genus *Lasioconops*. New. gen.

Head clothed with similar scales to *Culex*; antennae with the basal joint with a few scales; palpi short in both sexes. Thorax clothed with narrow-curved scales. Abdomen clothed with flat scales and with *large projecting flat lateral scales, with deeply dentate apices*, in more or less tufts. Wings with typical *Culex* scales and venation.

This genus is separated from *Culex* on account of the peculiar and characteristic lateral scales on the abdomen, which give the insect a ragged appearance.

A single species only at present occurs, *L. poicilipes* from West Africa. The ♂ is unknown.

XV. *Lasioconops poicilipes.* N. sp.

Anterior half of thorax with ashy grey scales and chestnut brown ones, the former towards the edge of the pale area, posterior part of the thorax dark brown with brown scales. Abdomen black, with basal white bands. Proboscis brown, with a pale median band. Legs deep brown, the femora mottled with creamy scales, the tibiae with a row of pale spots, metatarsi and tarsi with narrow basal pale bands, which to some extent involve the apices of the preceding segments.

♀. Head dark brown, with narrow-curved pale grey scales, brown and ochraceous forked scales and small flat grey ones at the sides ; antennae brown, basal joint black on the inside, with small white scales, and with a grey sheen on the outside, second joint bright testaceous ; palpi black scaled, with apical grey scales ; proboscis black scaled, with a pale median band ; clypeus deep brown, with frosty sheen.

Thorax black, the anterior two-thirds clothed with narrow-curved grey scales, palest at the posterior edge of this pale scaled area, where they form a wavy line ; posterior portion of the mesonotum with narrow-curved black and brown scales and numerous black bristles. Scutellum brown, with narrow curved dull creamy scales, and with eight black border-bristles to the mid lobe ; pleurae black, with patches of white scales and pale creamy hairs.

Abdomen black, with narrow basal bands of white scales and very large and peculiar white and ochraceous lateral projecting scales ; posterior border-bristles golden, short ; venter black, with white scales. Legs dark brown, the femora spotted and mottled with pale scales, the tibiae with small creamy spots ; metatarsi and tarsi dark brown, with narrow pale ochraceous bands involving both sides of the joints.

Wings with typical brown *Culex* scales ; surface of the wing with minute bristles ; first submarginal cell longer and narrower than the second posterior cell, its base nearer the base of the wing than that of the latter, its stem about one-fourth the length of the cell ; stem of the second posterior not quite one-third the length of the cell.

Supernumerary cross-vein not level with the mid cross-vein, a little nearer the base of the wing ; posterior cross-vein about two-and-a-half times its own length from the mid cross-vein ; sixth vein rather densely scaled. Halteres dusky ochre.

Length—6 mm. *Habitat*—Bonny, West Africa (Annett), and Gambia (Dutton). *Time of capture*—July (Annett), December (Dutton).

Observations—Described from a single ♀, somewhat denuded but easily told from all other Culicidae by the curious abdominal lateral scales, which are certainly of generic importance. The spotted legs give it some resemblance to *Culex tigripes*, but the banded tarsi and proboscis and general ornamentation will at once separate it.

XVI. *Mansonia uniformis.* Theobald

Mansonia africanus. Theobald

(*Mono. Culicid.* II, p. 180 (*Uniformis*) and p. 187 (*Africanus*) (1901) Theo.)

The collection contains ten specimens of this abundant African *Mansonia.* They were taken at McCarthy Island, in the marsh at the back of the town, and were noticed to bite very viciously. A single specimen was also taken in the prison at Bathurst, in October, the others were taken in December. Dr. Daniels has shown this *Mansonia* to be an intermediate host of the *Filaria.*

After carefully comparing a fresh series of South Indian and Ceylon *Mansonia* with the ones I described as *M. africanus* (*Mono. Culicid.* II, p. 187), I am convinced they are the same as the Indian *M. uniformis. M. africanus* must, therefore, sink as a synonym of *M. uniformis.* The thoracic ornamentation very soon becomes destroyed, and the thorax has then a non-ornamented or uniform appearance.

XVII. *Uranotaenia caeruleocephala.* Theobald
(*Mono. Culicid.* II., p. 256, 1901

I have described the ♀ of this species but not the ♂, a description of which is here given :—

♂. Thorax like the female, but the metallic patches in front and the lines in front of the wings very pale blue in certain lights. The head is brown and deep violet in the middle, with pale blue scales on each side ; palpi brown, proboscis brown, swollen at the apex ; antennae banded brown and deep brown, densely brown plumed. Abdomen showing a pale apical ventral spot on the fifth segment ; paler ventrally than dorsally ; fore ungues unequal, the larger sickle-shaped simple ; mid and hind apparently equal and simple, irregularly curved. Wings with brown veins, a line of metallic flat pale blue and violet scales at the base of the costa and another at the base of the fifth long vein, posterior cross-vein twice its own length distant from the mid cross-vein ; halteres with pale stem and brown knob.

Length—3 to 3·5 mm. *Habitat*—Gambia (Burdett ♀) and (Dutton ♂). *Time of capture*—December.

Observations—The ♂ is described from two fairly perfect specimens caught in a marsh behind the town on McCarthy Island. I feel certain from the thoracic ornamentation it is the male of *U. caeruleocephala* (mihi) described from Bonny. The chief difference from the female lies in the head being deep violet in the middle, instead of pale blue all over. The markedly bright brown thorax with the metallic white and pale blue ornamentation should at once separate it. I had to mount some of the legs of the ♂ type in balsam to make anything of the ungues. In doing so I misplaced them, so am not sure if the anterior or mid ungues are unequal.

XVIII. *Corethra ceratopogones.* N. sp.

♀. Thorax pale brown to fawn with darker brown markings ; metanotum pale chestnut-brown ; pleurae pale fawn and cinerous ; head brown, proboscis and palpi brown, with numerous rather long brown hairs ; antennae banded brown and grey. Abdomen very pale fawn to cinerous, with narrow dark brown apical borders to the segments, and dark brown at the sides, only partly, however, on the last two apical segments ; abdomen hairy ; apex dark brown ; lamellae brown.

Legs multibanded, with brown and frosty grey on the femora and tibiae ; fore femora with six dark bands and also the fore tibiae, apex and the basal band of both, pale ; metatarsus and first three tarsi banded with dark brown in the middle, apical joint pale, ungues very small, simple, and equal ; mid femora with eight dark bands, tibiae with six, the tarsal are broadest, base and apex of both joints pale ; metatarsi and tarsi with very broad dark median bands ; ungues small, equal, and simple ; hind femora with eight, and hind tibiae with seven dark bands, base and apex of each pale, metatarsus with two median dark bands, tarsi with a single median dark band. Ungues small, equal, and simple. Wings densely clothed with long brown hair-like scales, with three dusky patches on the costa, the median one where the sub-costal joins the costa spreading on to it, the apical one spreading on to the first long vein, the basal one rather indistinct, the median spread across the wing-field as a faint dusky band ; the third long vein is faintly darker than the rest. Wing fringe long and dense ; first submarginal cell considerably longer and narrower than the second posterior cell, its base very slightly nearer the base of the wing than that of the second posterior cell ; its stem about one-fourth the length of the cell, not quite so long as the stem of the second posterior cell ; stem of the latter less than half of the cell ; the second long vein carried a long way past the marginal cross-vein ; supernumerary and mid cross-veins sloping towards the apex of the wing ; posterior and mid cross-veins in one line. Halteres pale.

Length—2·5 mm. *Habitat*—Gambia (Dr. Dutton). *Time of capture*—December.

Observations—Described from a single ♀ taken by Dr. Dutton on the side of a tub on McCarthy Island. It is the only African *Corethra* known, and can easily be told by the wing ornamentation and

leg banding. The specimen is described partly from a xylol-balsam preparation. The mouth is provided with very distinct piercing lancets. It comes most near *Corethra brasiliensis*, but can at once be separated by the leg banding, wing venation, and spotting.

The great extension of the second long vein past the marginal transverse vein is a very marked character.

OTHER DIPTERA

Phlebotomus. Sp. ?

Several specimens of a large 'owl-midge' hatched out from pupae, taken in November and December from a duck pond. The species is probably new. It seems to be common in West Africa.

Tabanus dorsovitta. WALKER

Two specimens of this common West African gadfly, which bites severely, taken in mangrove swamps and called by Dr. DUTTON the large Mangrove fly.

Glossina longipalpis. WIEDEMANN
Var. *tachinoides.* WESTWOOD

Eight of this Tsetse fly were taken by Dr. DUTTON in November. It bites viciously along the river. It is closely related to the *Glossina longipalpis*, WIED., but constitutes a distinct variety. It was described by WESTWOOD as a distinct species. Mr. AUSTEN treats it as a variety of the type. Its possible connexion with the *Trypanosoma* in man has been referred to before.

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